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CONTENTS.

PAGE.

Art. I. Description of an Automatic Registering and Printing Barometer, by G. W. Hough, A. M., - - - 1

Art. II. A History of the Bills of Credit, or Paper Money issued by New York from 1709 to 1786, with a Catalogue of the Various Issues, their Denominations, Dates, and Signers, by John H. Hickcox, - - - - - - 23

Art. III. Preliminary Notice of the Fauna of the Potsdam Sandstone, with Remarks upon the previously known Species of Fossils and Descriptions of some New Ones, from the Sandstone of the Upper Mississippi Valley, by Prof. James Hall, - - - - - - - - - - 93

Art. IV. History of the Census of the State of New York, and Plan proposed for the State Census of 1865, by Franklin B. Hough, - - - - - - - - - 196

Art. V. Bibliorum Codex Sinaiticus Petropolitanus. The Sinai Bible, by Howard Townsend, M. D., - - - 229

Art. VI. Food and its Digestion, by Howard Townsend, M. D., - - - - - - - - - - - 241

Art. VII. An Essay on Motion and Force, by L. Allen, - 257

Art. VIII. Notices of Peter Penet, and of his Operations among the Oneida Indians; including a Plan prepared by him for the Government of that Tribe, by Franklin B. Hough, - - - - - - - - - - - - 275

Art. IX. Water and its Impurities, with reference to the Supply of Large Towns, by Jacob S. Mosher, M. D., - 304

TRANSACTIONS.

ART. I. *Description of an Automatic Registering and Printing Barometer*, by G. W. Hough, A. M.

[Fundamental principles of the method laid before the Albany Institute January 30th, 1865.]

The science of Meteorology is as yet in its infancy. Universally interesting as its phenomena have ever been, and powerfully affecting the most important relations of society, it is but recently that the subject has engaged the systematic and combined effort requisite for its development, since its laws are still regarded as the most recondite problem in Physics. The first thing to be done is of course the collection of facts, and much is now being done in England and on the continent in this direction. The chief obstacle, hitherto, has been in the imperfection of the methods of observation. The results, in order to be of value as data from which to construct a science, should present a *continuous* record of the phenomena during a considerable period of time, and taken at as many different stations as possible. By the ordinary method of personal observation, this is well nigh impracticable. It would demand at every station the services of several observers, at great expense, and their results could only at best be more or less of an approach to what is desired. To obtain this,

the only alternative is to substitute some mechanical means for the labor of personal observation; in short, to make the instrument record its own changes. If this can be done in a single instance, it can be done continuously.

The only method by which this has been hitherto attempted with success has been by the application of photography. This, though a very considerable advance, and probably all that could be desired in respect of continuity and accuracy of the record, is liable perhaps to the objection that it is too complicated a process for general use. If we consider the skill requisite in the preparation of the paper, the delicacy of manipulation involved by the apparatus, and the labor of interpreting the results, as compared with the average capacity and means of the great number of observers desired and likely to volunteer or be employed for such a purpose, it would seem that a simpler process is both desirable and necessary. This it has been my intention to furnish, and with what success remains for time and experience to determine. The importance of the subject will justify me perhaps in presenting some account of the new method.

The problem to be solved, was to cause any meteorological instrument, by means of suitable mechanism, simply and effectually to record its own changes. The instrument selected for experiment was the barometer. When any delicate instrument is made to record its own changes by mechanical means, the chief difficulty is that of getting sufficient power for the mechanism attached to make a distinct and continuous record, without taking a perceptible amount of force from the instrument itself, and thereby vitiating the results. The use of electricity naturally suggested itself as the best means of overcoming this obstacle. This agency has not as yet been made economical or certain as a motor, but is chiefly valuable in controlling power obtained through some other means. By it, as may be seen in its application to clock work, and in the telegraph,

the movements of one machine may be reproduced in another with no greater expenditure of force than is requisite for electrical contact. In the cases cited, however, the motion to be reproduced is sensibly uniform and in the same direction. For the solution of our problem, a mechanism is demanded that shall repeat the changes of the original in every form, whether the motion be uniform or variable, forward or reverse.

The feasibility of this plan was discussed with my friend Mr. Thomas Simons as early as the year 1862, and some steps were then taken to apply it to the thermometer. I may here express my acknowledgments to Mr. Simons for valuable suggestions in the construction of the present machine. Various plans were considered for effecting the electrical contact with the fluctuating medium which is the basis of this method. It was at first proposed to do this at the surface of the mercury in a syphon barometer, by means of a platinum wire which should be carried continually toward the mercury surface by suitable mechanism, and on touching the surface, a galvanic current would be formed which should operate by an electro-magnet on the mechanism so as to reverse the motion of the wire and break the circuit. This would be immediately restored by the normal movement of the mechanism, and thus the point of contact would be kept oscillating *at* the surface continually. The consumption of battery power by this plan would have been considerable, and it was thought the oxidization of the mercury by the electric circuit would in time be appreciable. It was therefore concluded to make the connection outside of the barometer tube, by means of a float resting upon the mercury column. By this plan there is no demand of action from the battery until some change takes place in the barometer, and a considerable saving of battery elements is effected.

Attention was then given to determining the degree of delicacy with which changes of the mercury surface could

be represented by this process. It was found by experiment that a motion of less than .0005 of an inch was readily shown, a quantity within the limits of reading of a first class standard barometer.

The next step was to devise the proper mechanism for repeating the motion thus transferred, and recording it in some legible form. A finely cut screw was considered as best adapted to measure such minute intervals of space. To this screw a forward or reverse motion was given by a double system of clock work, each operated by an electro-magnet in connection with the float, and raising or lowering the screw by intervals corresponding with the changes indicated in the mercury column.

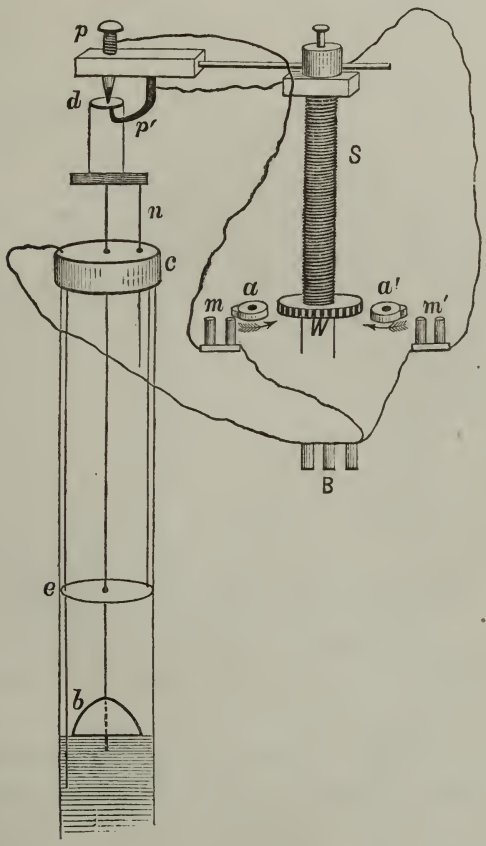
In respect to the permanent record of results, it was decided not only to attempt the production of a linear diagram or curve of atmospheric pressure, as an interesting method of presenting the recorded changes to the eye, but to avoid the tedium and uncertainty of measuring up such results, by producing at the same time a printed record of such variation, to any extent deemed advisable.

Having thus endeavored to give some conception of the design and principal features of this method, I will proceed to explain more fully the details of its execution as at present arranged.

In order to make any self-recording machine of this kind practicable, we need to attend to two points. First, to reduce the consumption of electricity to the smallest possible amount consistent with certainty in the results; and secondly, to secure the greatest amount of useful work with the minimum of labor. We at once decided to adopt the "make" circuit; for so long as there is no motion, there will be no consumption of battery elements. The battery which we have adopted for recording transits is essentially that of Daniell; sulphate of copper being the exciting agent. A battery of this kind will maintain sufficient power for chronographic records for two or three months,

without being cleaned; it being only necessary to add a little sulphate of copper and water from time to time, to supply the necessary waste. The only power demanded of the electro-magnets is the unlocking of the mechanism, which is driven by weight power.

Fig. 1.



In fig. 1, we have a sectional view of the lower leg of the siphon, showing the principle on which this method is based. It may be necessary to remark, however, that the electro-magnets and battery do not occupy these positions in reality, but are placed here for convenience of illustration.

Let B = battery.

" m, m' = electro-magnets.

" a, a' = wheels having one tooth, and revolving in the direction of the arrows.

S = screw supporting the arm, carrying two platinum wires p and p'.

d = platinum disk carried by the float b.

The two wires p, p', are respectively above and below the centre of the disk d.

W = wheel with 40 teeth in which is inserted the screw S.

n = a small steel wire passing through the brass cup c, to prevent the disk d from revolving.

e = an ivory disk inserted in the tube, to prevent the float b from rubbing against the sides of the tube.

Now suppose the mercury should rise in the short leg of the siphon, as represented in the figure. The float b will be raised, and cause the platinum disk d to come in contact with the point of the platinum wire p, closing the circuit through the electro-magnet m; the armature of which being attracted, unlocks the clock-work, and allows the wheel a to make a complete revolution. By this means the wheel W is advanced one tooth, which raises the screw S the $\frac{1}{2000}$ of an inch, and consequently carries the point p' that distance away from the disk d.

As long as the mercury rises, the magnet m will be operated, and the platinum point p will be constantly kept the $\frac{1}{2000}$ of an inch above the disk d.

If, on the contrary, the mercury falls in the siphon, the under side of the platinum disk d will be brought in contact with the point of the wire p', thereby closing the circuit through the magnet m'; the armature of which allows the one tooth wheel a' to make a complete revolution, thereby causing the screw S to be depressed the $\frac{1}{2000}$ of an inch, carrying, of course, the platinum point p' with it.

It will now be readily seen how the platinum disk d,

carried by the float b, may always be maintained midway between the two points p and p', and distant a little less than the $\frac{1}{2000}$ of an inch from each.

The barometer is of the siphon form; the inside diameter of the portions near the surface of the mercury is nearly one inch. The upper and lower portions were made from the same glass tube, the two being connected by a tube of smaller diameter. We have not yet tested it sufficiently to determine the correction for the difference in size between the two legs. The observations, however, so far seem to indicate a very perfect tube.

The float b is of ivory; the form, a paraboloid of revolution. The under side of this float is very slightly concave. The diameter is one-eighth of an inch less than the inside diameter of the tube, so that there is no friction between the sides of the float and glass. The platinum disk d is supported by a steel wire passing through a brass cap c fitted on the top of the tube, and an ivory disk e inserted at a distance of $2\frac{1}{2}$ inches above the float b. The ivory disk is connected with the brass cap by means of two wires, so that it can readily be removed. A light steel wire n passes through a hole in the cap, for the purpose of preventing the disk d from revolving. This is made sufficiently free to prevent any friction.

The disk d is made of brass one-half an inch in diameter, and is covered on both sides with platinum plates.

The platinum wire p is attached to a fine screw, for adjusting the distance of the points p and p' from the surface of the disk d.

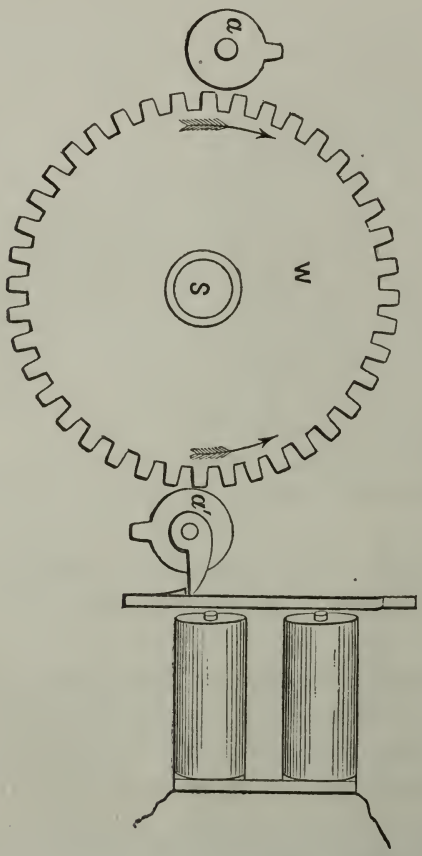
These wires p and p' are, of course, insulated by being attached to an ivory block, as shown in the figure. The wires from these points are led to the top of the screw S, where they are fastened to an ivory block, after which they are connected with the electro-magnets m, m'.

A fine platinum wire is inserted in the side of the

barometer tube, and passes down in the mercury on the side of the float *b*. This wire is also connected with one pole of the battery.

The principle employed for giving motion to the screw *S*, which follows the fluctuations of the mercurial column, has been taken from the stop work long used on clocks. The barrel of a clock on which the cord is wound usually has a one-tooth wheel on its axis; and at every revolution of the barrel, a cog wheel is made to advance one tooth. This cog wheel is, of course, always detached from the

Fig. 2.



barrel tooth wheel, except when in the act of advancing the tooth. In fig. 2, we have a vertical view of a portion of the mechanism, showing the method of communicating motion to the screw *S*. The one-tooth wheels, *a a'*, when at rest occupy the positions as shown in the drawing; and being detached from the cog wheel *W*, it is free to move in either direction. The screw *S*, which is shown in fig. 1, is raised or depressed by the revolution of the wheel *W*. The one-tooth wheels *a* and *a'*, moving in the direction of the arrows, give opposite motions to the wheel *W;* the office of *a* being to elevate the screw, and of *a'* to depress it, corresponding to the fall and rise of the mercurial column.

The mechanism for giving motion to the wheels *a* and *a'* is ordinary clock work, each being directly acted on by the barrel wheel, which is driven by a weight. One revolution of the barrel corresponds to twelve of the wheels *a* and *a'*. The axles, to which are attached *a*, *a'*, carry another wheel having a single half-tooth, as shown in the drawing, fig. 2, which, resting against a little projection on the armature of the magnet, holds the wheel in the position as shown in the figure.

In order that the wheels *a* and *a'* may not revolve with too great rapidity, a train of clock work is connected, consisting of two additional axles, a fan being attached to the latter, by means of which the motion can be regulated to any desirable velocity. Three axles would undoubtedly be sufficient, the barrel axle, the axles *a*, *a'*, and an additional one for the fan. We adopted the present form, because we happened to have a couple of clock movements at hand, and used them just as they were.

In our first experiments, it was found, when the points *p*, *p'* were adjusted very close to the surfaces of the disk *d*, the oscillations of the barometer were liable to cause both wheels *a*, *a'* to revolve at the same time; and by this

means, should their cogs arrive at the circumference of W together, the machine would become blocked.

This was easily remedied by introducing a circuit "breaker" on one of the wheels a, a'. As soon as the wheel a begins to move, the circuit is broken, and remains so until it comes to rest again; so that in case they should both start at the same instant, the cog of a' being in advance, it would make its revolution and come to rest, because the circuit would be interrupted until a should come to rest also. Since the circuit interrupter was attached, there has been no difficulty from this cause.

Fig. 3 is a perspective view of the apparatus as it is when in operation. The frame work for supporting the barometer tube and other mechanism is of black walnut two inches thick, which is firmly fastened to the east wall of the west transit room. This wall is built of brick, and is two feet thick, so that the whole apparatus occupies a very firm position.

Having given a general idea of the mechanism for causing the screw S to follow the motions of the barometrical column, we will show how the curve of pressure is recorded, as well as the printed results.

The wheel W, fig. 2, which receives the impulses, has 40 teeth; and the screw S, having 50 threads to the inch, one tooth of the wheel W corresponds to the $\frac{1}{2000}$ of an inch change in the barometrical column, or $\frac{1}{1000}$ of an inch change of pressure. To the wheel W is attached another of nearly the same diameter, having 80 teeth; this wheel is geared into one of 40 teeth carrying an 80-tooth wheel on the same axle. This second 80-tooth wheel is geared into a 50-tooth wheel, which operates the screw S', fig. 3, of 26 threads to the inch. To this screw is attached an arm, carrying a pencil which traces the curve of pressure on the revolving cylinder o.

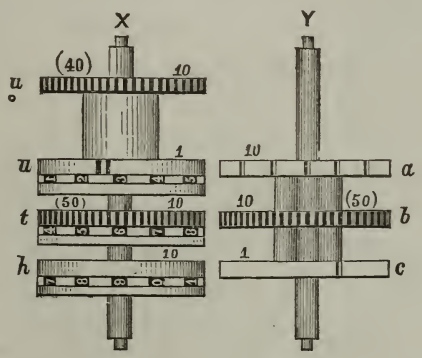
From this arrangement, the curve is magnified a little

more than three times the barometrical pressure. It would have been an easy matter to adapt the second screw and cog wheel, so that the curve would be exactly an integer scale — say 1, 2, 3 or 4 times; but as our printed results may be obtained much more accurately, and as often as is necessary, it was not thought of sufficient importance to construct a screw especially for this purpose.

We will now explain the mechanism for printing the results.

A sectional view of the combination is shown in fig. 4, where x and y are two vertical steel axles. The final result expressed in thousandths of an inch, is found on the axle x, where u is the units wheel, t tens, and h the hundredths; or where the thousandths of an inch is the unit of measure, u will represent thousandths, t hundredths, and h tenths of an inch.

Fig. 4.



The wheel u_0 may be supposed to have ten teeth, and is connected with u, so that they move together. If motion be given to u_0, so that it move one tooth at each impulse, each tooth will represent the $\frac{1}{1000}$ of an inch; and ten impulses, or a whole revolution, will represent the $\frac{1}{100}$ of an inch. The wheel u has one tooth, and the

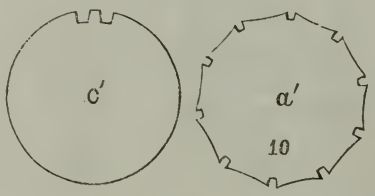
wheel a on the axle y has ten teeth. Now when u has made a complete revolution, it will have advanced a one tooth or one-tenth of a revolution; consequently the wheel a will always express the hundredths.

In order to transfer the motion of a to the axle x, we fasten to a the wheel b, having ten teeth; and by gearing this in the wheel t, having ten teeth also, we transfer the motion of a to t, hence we have the thousandths and hundredths expressed on the wheels u and t.

But let us go a step further, and see how we get our tenths. The wheels a, b, we have shown, indicate the hundredths: we therefore attach to them another wheel c, having one tooth. Let the wheel h of ten teeth be placed opposite. Now when the axle x, carrying the wheels a, b, c, has made one complete revolution corresponding to one tenth, the wheel h will have advanced one tooth; consequently the tenths will be represented on the wheel h.

It is of course understood that the wheels u, t, h, are separate, and free to move about the axis x. By repeating this combination, we can employ any number of figures we choose.

Fig. 5.



The wheels u, h, a and c, are made after the plan employed in the stop work in a chronometer. In fig. 5, a' and c' indicate this form of gearing. It is seen that the teeth of one wheel are cut in the arc of a circle, with the radius equal to that of the wheel into which it gears. This arrangement prevents any motion, except it be communicated by the units wheel. The whole mechanism is therefore

locked together, and it is just as impossible for it to get out of order as it is for ordinary clock gearing.

The chief merit of this combination is, that it will carry for ten either forwards or backwards. This principle is necessary in any meteorological printing instrument. We need no extra apparatus for bringing the type in line, since if the mechanism is well constructed, it will always arrange itself. When once set it will remain so, for no change can be made without ungearing the machine.

We use ordinary type which are set in separate disks, being afterwards screwed fast to *u*, *t*, and *h*. In case a type is accidentally damaged, or broken, another can be inserted in a few minutes. Steel type would undoubtedly be the best, as being more durable and less liable to damage. We should add, that the wheels *t* and *b* have each 50 teeth; five teeth being moved at one impulse.

The printed results are received on the strip of paper *j*, moved by the clock-work *k*, fig. 3, which at the same time regulates the revolving cylinder *o*, on which is traced the curve of pressure. This same clock raises a small hammer *h*, by means of a screw or spiral on the minute wheel arbor, which at every revolution is allowed to strike the small cushion *i*, by that means leaving the impression of the type on the paper strip. In order to secure greater distinctness in the printed results, without employing much power to make the impression, a strip of duplicating impression paper is inserted between the type and ordinary sheet of white paper.

We are not limited in our printing to hourly records, but they can be obtained as often as it is desirable, by supplying the additional power required to raise the hammer. The clock for moving the printed slip and cylinder is an ordinary half-second's pendulum, which we happened to have at hand. It was not thought necessary to print

the integer number of inches, nor the time; for the paper slip has the time already printed on the side, so that when the record of the day is completed, it is only necessary to add the date and integer inches.

One great advantage in the use of this instrument consists in the ease with which it may be manipulated. All the adjustments are simple and easily accomplished. Any person could learn, in a few days at most, to keep it in running order, and make any adjustments, should it become necessary from accident or other causes. No chemicals are needed, except the sulphate of copper for the battery, which may readily be procured in any town or village. Every part of the action is visible to the eye of the observer, so that in case any part gets out of order, it will readily be seen. We believe this instrument would be of great value at the Government stations in remote localities, where systematic meteorological observations are carried on. A standard barometer might be read once every day, to guard against any error from change of zero, from accident or other cause. There is no portion of the machine which is liable to get out of order. Perhaps after long use the numbers on the type-wheels may become clogged by the use of the impression paper, thereby impairing the distinctness of the printed record; but should this trouble be found to occur, they can readily be cleaned with a brush without disturbing any adjustment. Thus far we have found no difficulty from this cause. The impression paper is not essential, even with the present plan of printing. We only use it to get greater distinctness; in fact, our records look like ordinary print. By applying a little more power to the hammer, a very good impression is obtained without its use. If steel types were used, with good card-board, a distinct impression

could be obtained without interposing any substance; and these would undoubtedly be the best, as less liable to injury from accident.

As before remarked, we have adopted the siphon form of barometer; but we are not limited exclusively to this: since an ordinary cistern barometer could have been used with equal facility, by simply inverting it and bending the lower end in a siphon form. With this we would get nearly double the motion which we now obtain, for the same amount of pressure; but there would be a variable correction which it would be necessary to apply to every record, for eliminating the error due to capacity of cistern. By making the cistern large in diameter and the siphon small, this correction might be reduced to a small quantity; yet where we desire accurate results, it would nevertheless be necessary to apply it.

Taking all the advantages and disadvantages in consideration, we decided in favor of the siphon proper; so that now our results are printed in decimal parts of an inch, with no correction of any kind to apply.

The screw *S*, on which the accuracy of the results will in a great measure depend, is, as before remarked, 50 threads to the inch, and was cut by Mr. Charles Fasoldt; and it is believed to be a very perfect one. We have as yet not had a sufficient number of comparisons to determine the eccentricity or irregularity, but it is presumed that it will not be appreciable on the results.

The best form and arrangement of the float can only be determined by experiment. In our original barometer tube, which was 0.4 in. diameter, we inserted an ivory float which nearly fitted the tube. The upper end of the wire for supporting the platinum disk *d*, was connected with the arm carrying the platinum points. This form worked very well, as the following results will show. The instrument was allowed to run from April 24th to 30th, without

being disturbed. It was set with the standard barometer (Fastré), at 4 p. m., April 24th.

1865.

Date.		Temperature. Centigrade.	Standard Barometer reduced to 0 deg. Cent.	Printing Barometer reduced to 0 deg. Cent.	Difference.
Apr. 24,	4h.	8.5°	29.947 in.	29.947 in.	+0.000 in.
" 25,	22	10.0	29.934	29.929	+0.005
" 26,	2½	13.0	29.789	29.784	+0.005
" 27,	21½	13.0	29.862	29.859	+0.003
" 30,	0	12.0	29.755	29.750	+0.005

During this period the barometer reached a maximum of 30.114, and a minimum of 29.435.

On the 30th, the machine was taken down to modify the printing apparatus.

A comparison of these results show that even with inferior and comparatively rough apparatus, the individual results are equal to a reading obtained from the best standard barometer. For when we consider that the error of the temperature constant, for the new apparatus, may in this case, even for a difference, of 5° amount to 0.005 in., it would show that the errors introduced by the mechanism are almost inappreciable. At this time the registering barometer was not compensated for temperature; the reductions being made from a short table computed for this purpose.

The reduction of the barometrical results to 0° Centrigrade or 32° Fahrenheit, can be accomplished by supporting the barometer tube by means of a combination of brass rods; the office of these rods being to carry the whole barometer tube in an opposite direction over a space equal to the motion of the mercurial column from the effect of temperature. An apparatus of this kind has been used in the construction of the photographic barometer at the Radcliffe Observatory. In the place of zinc rods there used, we propose to employ brass tubes.

The amount of compensation will be determined from direct experiment, or comparison of the printed results,

with the standard. The new apparatus can be treated precisely in the same manner as a pendulum. The standard barometer may be allowed to remain in the same temperature, while the new apparatus is subjected to a degree of heat sufficient to get a variation of 50° Fahrenheit. A comparison of the printed results with the standard will indicate the exact compensation necessary for the whole apparatus. After the compensating rods are applied, the experiment can be repeated until the adjustment is perfect.

Numerous experiments have been made to test the stability of the float and magnetic connections. It will hardly be necessary to give the results in detail. In case there was no friction of any kind, the float ought always to assume the same position for the same height of the mercurial column. The following is the test we have applied. The electrical contact being broken by the key *l*, fig. 3, the screw *S* was turned so as to force the float into the mercury 0.010 of an inch; after which, the current was established, and the float was allowed to take up a position of equilibrium. The same thing was repeated, by turning the screw in the opposite direction and lifting up the float. From many trials, it was found that there was rarely a difference of 0.002 of an inch, and usually less than 0.001 of an inch, from the original position. The same test was applied for larger disturbances, viz. 0.020 or 0.030 inches, with nearly similar results. This is not a fair test, however, since these conditions are never realized in practice. From all our experiments so far, we see no reason why the machine should change its zero any appreciable amount, during a whole year or greater length of time.

The following curve of pressure and copy of the printed results, from May 11th noon, to May 12th noon, will show what the machine is capable of doing.

The curve is rather a remarkable one, from the fact that apparently there was but little atmospheric disturbance at this place. It shows, however, that the atmosphere was in a violent state of agitation, from 3 p. m. of the 11th, to 4 a. m. of the 12th.

During the afternoon of the 11th, the weather was very changeable; clouds were continually passing over the heavens. At 6 p. m. it began to rain, and continued with intervals of intermission until some time after midnight. During the afternoon and evening, the wind blew rather strongly from the southwest, but was at no time very violent here.

But at other points 200 miles to the east and south of this city, the wind blew a tornado, doing considerable damage to property. At New York, it was most violent between 6 and 7 p. m.

The following is a *fac simile* copy of the record as printed by the machine. The numbers on the left hand are the hours from noon of the 11th to noon of the 12th. The remaining figures are the barometrical heights expressed in thousandths of inches.

DUDLEY OBSERVATORY.

May 11th, 1865.

Time.	Barometer.		
	29 in.		
HOURS.			
0	7	0	4
1	6	9	6
2	7	0	9
3	6	8	8
4	6	9	2
5	6	8	1
6	6	9	0
7	6	8	9
8	6	8	0
9	6	6	2
10	6	5	8
11	6	7	0
12	7	3	6
13	7	0	0
14	7	0	1
15	7	1	8
16	7	7	6
17	7	8	3
18	7	8	4
19	7	8	9
20	7	9	0
21	7	8	3
22	7	8	5
23	8	0	1
0	8	0	4

One of the peculiarities of this method is, that we can print our results at any number of places, provided we have telegraphic communication. One standard barometer may be made to record its indications at fifty different points at the same instant.

This method may be employed for measuring the fall of rain, and the results can be printed to thousandths of inches every hour, or as often as it is desirable. The general plan will be to receive the rain in a glass siphon containing mercury. One leg of the siphon may be inserted in a brass tube of uniform diameter, of 3 feet in height. Let us suppose that the mercury stands three inches high in each leg of the siphon. If water be poured in the brass tube, the mercury will of course rise in the short leg, and may be made to support a float with machinery precisely similar to that used for the barometer. The area of the vessel receiving the rain can be such that the mercury in rising will measure the amount of rain fallen in decimal parts of an inch. When the water is drawn off, the machine will of itself come back to the zero. If desirable, the apparatus for carrying ten can be so modified that it shall only act in one direction, viz. when the mercury is rising in the short leg; in this case, we would, at the end of every month, have the total amount of rain fallen, and the same for the year. This form would probably be preferable, because when the water is drawn off, if any quantity should remain in the tube, it would have no effect on the accuracy of the results.

In applying this principle to the registration of the temperature, we would use a simple metallic thermometer. A motion of two or three inches for 100 degrees Centigrade is amply sufficient to measure with certainty tenths of a degree. After having determined the scale of the instrument, it becomes an easy matter to adapt mechanism which shall print the results in degrees and decimals,

without the necessity of any subsequent reductions. The curve for temperature and rain can be recorded on the same cylinder. One battery will be sufficient for all the instruments.

For the registration of the force and direction of the wind, the printing portion of the mechanism will be of great value; since it will be an easy matter to connect it with an Anemometer, so as to print the direction in degrees of the circumference, and the force or velocity in pounds or miles. Whether this method can be applied successfully to magnetical instruments, remains to be determined; but without having made any experiments in this direction, we see no serious obstacle in the way of its application.

The error of reading a first class standard barometer is considerable; chiefly owing to the difficulty in bringing the surface of the mercury in the cistern to the zero of height. We speak now of that class of barometers where the surface of the mercury in the cistern is brought in contact with the point of an ivory pin. The uncertainty of making an exact contact may effect the readings to the extent of 0.008 of an inch. The mean error for reading our standard barometer, *Fastré*, tube of one half inch diameter, and cistern of two inches diameter, is nearly 0.004 of an inch. We also find that there is a personal equation existing between the readings of two observers, mostly due to this cause. This personality, between my assistant Mr. McClure and myself, amounts in the maximum to 0.005 of an inch. It is also found that readings made by the light of a lamp are not the same as the daylight readings; the difference in some cases amounting to 0.010 of an inch.

It is proposed to obviate a large source of these difficulties by using electrical contact to bring the surface of the mercury in the cistern to the zero. This can readily be done at fixed stations, where meteorological observations

are carried on, with but little trouble. In place of the ivory pin usually employed, we would substitute a double platinum pin; one point of which should pass through a small metal disk resting on the surface of the mercury in the cistern, and the other, placed above the surface of the disk. If these two pins are insulated, and connected with the poles of a galvanic battery, when the mercury in the cistern is raised, bringing the metal disk in contact with the platinum point, the current will be established; and an audible signal can be given by means of an electro-magnet. By this means we eliminate all errors and personal equation, in determining the zero of the cistern; and consequently the remaining error of reading will be confined to the bisection of the upper surface. The actual test of the magnetic connection as applied to our barometer gave the following results. We would remark, however, that no metal disk was employed, but one platinum wire was plunged directly into the mercury, and the other was made of the same length as the ivory pin, and only touched the mercury when the contact was made for bringing the mercury in the cistern to zero.

A large number of readings made by Mr. McClure and myself, showed that by this method the personal equation was entirely eliminated; the mean of five or ten consecutive readings not differing by an appreciable quantity. The mean error for a single reading amounted to 0.001 of an inch, and the maximum error to 0.002 of an inch; showing conclusively that the chief source of error in reading a barometer lies in the adjustment of the surface of the mercury in the cistern to the zero.

ART. II. *A History of the Bills of Credit or Paper Money issued by New York from* 1709 *to* 1786, *with a Catalogue of the various Issues, their Denominations, Dates and Signers. By* JOHN H. HICKCOX.

I.

The representative of currency used in America during the earlier period of colonization consisted of peltry and wampum.[1] The former was offered in almost unlimited quantities; the latter, called also *zewan* by the Dutch, held an arbitrary value for many years.[2] Both were repeatedly recognized as currency.[3] The necessity for coin only partially existed, and its circulation in New Netherland, at least during the administration of the West India Company, was limited. Indeed a small amount was sufficient, as the general dealings of the community were by trade or barter. Beaver was for a long time the standard. Wampum never had a fixed value,[4] but varied from four to

[1] Said to be derived from *wampi*, signifying in Massachusetts Indian language—*white*. It was strung, and sometimes formed into belts.—*Encyc. Amer.*

[2] Its manufacture by the natives was necessarily rude. They commonly used the oyster and clam shell. The beads were bored with sharp stones, and strung upon sinews. The dark bead, less than an inch in length and bored longitudinally, was of the greatest value and more highly esteemed than European gold and silver. The Dutch somewhat improved it and made use of white and blue beads, which were manufactured from the sea conch and muscle. A string one fathom long was valued at four guilders, or one dollar sixty-six and one half cents of our currency—Munsell's *Annals.*

[3] *N. Y. Col. Docs.*, I, 87, 303; II, 594, 697, 703. *Albany City Records* Sept. 23, 1686, etc.

[4] *Col. Docs.*, III, 303.

eight black beads for a stiver. The repeated complaints on the subject of its fluctuation seem to have been unheeded by the directors of the company, who would have the colonists consider it as good as bullion, yet would receive only beaver skins in payment of duties and taxes,[1] while supplies could be obtained only for beaver or silver.

That there was however at an early date a supposed scarcity of coin, appears from the fact that in 1642 the council petitioned the company to raise the value of money in order to prevent its exportation to foreign countries;[2] and at a later period Governor Stuyvesant endeavored to introduce a specie currency, and as one expedient proposed in imitation of New England, to establish a mint at New Amsterdam.[3] In 1673 there was little or no certain coin. Wampum passed for current payment, and it continued to constitute the currency of the common or laboring people long after the colony ceased to belong to the Dutch.[4]

In most of the other provinces a barter trade was carried on similar to that of New Netherland. Wampum was introduced into New England by Isaac De Razier in 1627, and passed at the rate of 5s. per fathom. The general court ordered in 1643, "that wampumpeag should pass current in the payment of debts to the amount of forty shillings." Besides this, English and Dutch coin, Indian corn, wheat, rye, barley, peas, live stock, beaver, bullets and gunpowder, constituted its currency during the early days of that colony.[5]

[1] *Col. Docs.*, I, 203.

[2] O'Callaghan's *New Netherland.*

[3] *Manuscript Records*, Secretary's Office, IV, 387, 388.

[4] In 1683, the schoolmaster in Flatbush was paid his salary in wheat, "wampum value," and ten years later, the ferriage for each single person from New York to Brooklyn was eight stivers in wampum, or a silver two pence. — *O'Callaghan.*

[5] In Massachusetts (1631), the following enactment was made: "It is

Virginia in 1618 made the following enactment—"All goods shall be sold at an advance of twenty-five per cent, and tobacco taken in payment at three shillings per pound, at not more or less, on the penalty of three years servitude to the colony."[1]—Other colonies at this date had similar regulations; and as late as 1790 inspector's receipts for tobacco which had been lodged in the ware house, to await exportation, passed current as cash.

In Pennsylvania, about the year 1700, a proposition was brought before the general assembly to make domestic products a legal tender, at their current rates, although according to one account[2] specie was more plentiful in that province than in England. As late as 1732 in Maryland, an act was passed making tobacco a legal tender at one penny per pound, and Indian corn at twenty cents per bushel.

II.

The Introduction of Paper Money into America.

The introduction of paper money into America, as a medium of exchange, was made in Massachusetts. Prior to the year 1652 bills passed current in the payment of debts.[3] In this year, the subject was discussed in the general court with the view of increasing the facilities of trade. No enactment followed, but we find an approximation to it in 1675 in the following record: "For the prevention of the charge and trouble of transportation of the

ordered that corne shall passe for payment of all debts at the usual rate it is solde for, except money or beaver be expressly named." Again in 1635—"It is ordered, that hereafter farthings shall not passe for currant pay. It is likewise ordered, that muskett bulletts of a full boare shall passe currently for a farthing a peece, provided that noe man be compelled to take above 12*d.* att a tyme of them."—*Mass. Records.*

[1] Holmes's *Amer. Annals.*

[2] Thomas's *Account of Pennsylvania*, 1698.

[3] Felt's *Account of Massachusetts Currency.*

rates to be leveyed, to the treasurer of the county, as also matter of convenience therein appearing, it is ordered that bills for wages, horses, provisions, &c., being regularly passed to the sayd treasurer, the Treasurer upon the desire of persons concerned shall repass bills to the constables of such townes, where sums are due upon the aforesaid accounts."[1]

In 1686, during the presidential government of New England, permission was granted to John Blackwell of Boston, and others, residents of England as well as of this country, to commence the issuing of bank-bills "on the security of real and personal estate and imperishable merchandize." How far and how long the operations of this corporation were carried on, is not precisely known.

It was in 1690 that the first issue of paper money was made by an American colony. New England and New York undertook to drive the French from Canada. The expedition failing, the soldiers returned sooner than was expected, and were clamorous for their pay, and being unwilling to await the time necessary to raise a revenue by a direct tax, the authorities of Massachusetts resolved in the emergency to issue a paper currency, and thereupon directed a committee to prepare immediately bills to the amount of £7,000.[2] Many precautions were made in order to preserve their value, but depreciation speedily followed their issue. The government received them at par in payment of taxes, and added five per cent to the principal, so that they soon became objects of speculation.

The next colony which issued paper money was Carolina, the necessity for which grew out of an expedition against St. Augustine in 1702. Bills of credit to the amount of £6,000 were issued, to be canceled in three years, by a duty laid upon liquors, skins and furs. In

[1] *Massachusetts Records.*

[2] According to Hutchinson these bills were issued in notes from 2*s.* to £10. Mr. Felt says from 5*s.* to £5.

1705 or 1706 a paper money act was passed in the island of Barbadoes. These three instances are believed to be the only enactments creating bills of credit in the British American colonies prior to the acts passed in Connecticut at the session begun in May, 1709, and in New York, June 8th, of the same year.

III.

The Paper Money of New York.

New Netherland was surrendered to the English in 1664, the Duke of York having obtained a grant of the province from King Charles II. The Dutch reconquered the country, but it was eventually restored to the English in 1674, when the Duke obtained a new grant of the colony of New York. The government was composed of the governor and council appointed by the king, and subsequently of the assembly chosen by the people. In it was vested the authority to make laws, subject to the approval of the proprietary. The general assembly convened for the first time in 1682.

Difficulties in regard to the currency of the province existed at an early date. The coins of Holland, France, Germany, Spain, England and a remnant of the Massachusetts coinage carried with them each the distinct valuations made in their respective countries. As has already been stated, wampum circulated for a long time as the colonial currency, but it gradually disappeared as trade and prosperity increased, when the revenue for the support of government was derived from crown rents, forfeitures, taxation,[1] duties, the emission of paper money and lotteries.

After the first reduction of New Amsterdam, the necessary means to defend it against the Dutch and Indians

[1] The first internal tax in New York (New Netherland) was levied in 1644, and was for the purpose of meeting the expense incurred by the Indian wars.

exhausted the money and credit of the colony.[1] Trade became much reduced, and supplies from England were protracted and small. Even the private resources of the governor were exhausted. He complained that "he was utterly ruined in his small estate and credit." During the administration of Gov. Andros frequent efforts were made to increase the supply of money, which was represented as insufficient for an ordinary commerce. The importation of British brass farthings, restamping Spanish pieces-of-eight,[2] the special coinage of a few thousand pounds for circulation in the province, were plans severally suggested, neither of which received material encouragement. Gov. Dongan, and subsequently the Earl of Bellomont,[3] recommended the establishment of a mint, which suggestion the duke's commissioners signified their willingness to consider, but no further notice appears to have been taken of it.

The low state of the currency it was thought, arose from the fact that most of the foreign trade came through Boston and other places of the East, which tended to draw in that direction the money as well as produce. In view of such facts the merchants of New York petitioned the general assembly for enactments which it was imagined would increase the supply of currency. It was, in fact, injudicious legislation which had already removed the currency from the province; it was now proposed that no wheat should be exported from the province save only for the Madeira Islands; that the ten per cent. formerly laid upon all European goods that did not come directly from England hither, over and above the two per cent. already imposed, should again be required.

[1] In raising 300 men for the protection of the frontier, it was found necessary to require each county to raise, pay and maintain their own men, according to the proportion then agreed upon.

[2] 1675.

[3] Aug. 27, 1684 and 1700.

The instructions from the government were stringent and reiterated that no alteration should be made in the value of current coin. It was nevertheless subject to constant change, for we find that in 1695, the difference between New York and sterling money was about one fifth, and in 1700 about one quarter. Difficulties were increased too by the diverse values held in the several colonies. Pieces of eight of the value of 6*s.* passing in New York for 6*s.* 9*d.*, in New Jersey for 7*s.* 8*d.*, in Maryland for 4*s.* 6*d.*, and in Virginia and Carolina for 5*s.* To relieve these embarrassments the queen in 1705, issued a proclamation settling and ascertaining the current rates of coin in the plantations.

Against this the merchants of New York remonstrated on the ground of the frauds committed under it, inasmuch as in some of the provinces the proclamation was duly published, but no notice taken of it. Lord Cornbury was induced to take the responsibility of suspending it. The assembly afterwards assumed the right to settle the value of coin in a manner to meet the view of the colonists, for which proceeding it was censured by the government.

A few years later (1708) the legislature passed an act regulating and preventing the corruption of the current coin, which, although favorably commended by Lord Cornbury, was reported against by the lords of trade on the ground that coin was raised to a higher rate than was allowed by the act of parliament and the proclamation. It was subsequently vetoed, and the veto published in New York and New Jersey. The legislature, however, disregarded the veto, and resolved to pass no bill for money for the support of government unless at the rates contained in the vetoed bill. Governor Hunter dissolved the house several times, but to no purpose; both he and all the government officers remained without support for a number of years. He was finally under the necessity

of conceding, and the assembly appointed a treasurer to receive and pay all money granted to the king and the province, in place of the king's receiver general. A few years later, parliament having passed an act regulating, on a uniform scale, the rates of foreign coin in the plantations, the general assembly remonstrated on the ground that if money passed at the same rates here as at the West Indies, it would not be worth the merchant's while to bring the money, but rather the produce of those islands in return for our produce; and as our principal commerce was to those parts, there would not be brought back money enough to support either the government or commerce. It was claimed that the effect of both the proclamation and the act of parliament would be to establish in the colonies a depreciated currency, and drive all the gold and silver coin to England, and it was urged, therefore, that assent should be given to an act which the assembly had recently passed, regulating the currency of the colony. This act provided that Spanish pieces should not pass at less than eight shillings per oz., troy—whereas the proportion in the act of parliament was 6*s.* 10*d.* In the absence of the royal assent, the governor, as requested, ordered the execution of the latter (New York) act.[1]

As has already been stated, New England and New York undertook, at the instance of the British government, to drive the French from Canada, circular letters having been addressed by the officer of the crown to the governors of the American colonies, directing them to assist in carrying on the expedition. A proposition was immediately passed upon in the house of assembly of New York[2] to raise 487 men as her quota for this purpose. It was enacted that a tax of £6,000 should be levied, but as funds were needed immediately, another act

[1] It was subsequently reported against by the board of trade, and vetoed by the queen.

[2] May 25, 1709.

followed[1] enforcing the currency of bills of credit to the amount of £5,000. This was the first paper currency act passed in New York.

Although New England, New Jersey, and Pennsylvania joined New York in this operation against Canada, the latter contributed more than any of the other colonies. In the New Jersey and Pennsylvania legislatures the Quakers voted against the appropriations, and in the former colony defeated them, but subsequently the bill was reconsidered and passed. The expense incurred by New York was above £20,000.[2] Other enactments creating bills of credit for the same object, followed the one already mentioned. In November, 1709,[3] two were passed, one for the currency of bills to the amount of £4,000, another for ten thousand ounces of plate, or fourteen thousand five hundred and forty-five Lyon dollars[4] (equal to £4,000). These bills were for a short time received by the treasurer at their value with an advance of $2\frac{1}{2}$ per cent. from the date of the bill to the day the treasurer received them. The regulation, as had been the case in Massachusetts, induced many to hold them on account of the accumulating interest; but at the next session an act was passed forbidding the treasurer or any other person paying or receiving any interest on their account. The bills then issued, as well as those emitted subsequently, were canceled as they were paid in. To counterfeit them was felony without benefit of clergy.

Although the expedition against Canada was unsuccessful, a few operations in Nova Scotia and Newfoundland which had resulted favorably, stimulated a renewed attack against the former. Assistance arrived from England and Flanders. The general assembly convened, and the sub-

[1] June 8, 1709.

[2] Smith's History.

[3] November 1st and 12th, 1709.

[4] The value of Lyon dollars in 1711 was 13 pwt. 18 gr.; in 1720 15 pwt.

ject was brought before it. Some dissatisfaction arose as to the large proportion required of New York, but in a few days[1] an act was passed to raise a force of 600 men in connection with 360 from Connecticut, 360 from the Jerseys, and 240 from Pennsylvania. A new issue of bills of credit was ordered to the amount of 25,000 ounces of plate, or £10,000, to defray the expense. They were to be current not longer than eight years. Every collector of taxes was required to indorse on the bill the date of payment, after which time the bill so endorsed was no longer current.

Owing to bad management, and the wreck of a number of vessels, failure ensued, the troops returning home without even an encounter.

The state of affairs in New York at this time, was by no means harmonious. Discouraged by recent disasters, the ill feeling between the governor, council, and assembly, manifested itself on several occasions. The province was largely indebted to individuals for money and effects, advanced for the service of the army. Provision had been made by former governors for the payment of a great part of these claims, out of the funds which had been from time to time raised for the support of government. Warrants had been signed and issued, but the sums having been misapplied, the debts remained upon the colony: the government credit was low, and the inhabitants quite discouraged.

In order to relieve difficulties, which were daily becoming more complicated, an act was passed in 1712, under which commissioners were appointed to examine and state the several debts claimed to be due from the government. In order to discharge the debts thus ascertained, another act was passed in 1713, laying an excise on all strong liquors retailed in the colony. It was to continue in force from 1714 to 1734, and the money arising thereby, appropriated to discharge the public debts, as subsequently

[1] July 26, 1711.

directed. Nearly the whole session of 1714, was consumed in discussing the subject. Governor Hunter informed the assembly, that he would pass no law until provision was made for the relief and support of government. The assembly finally yielded, and passed an act[1] "for paying and discharging the several debts and sums of money claimed as debts of this colony to the several persons therein named, and to make and enforce the currency of bills of credit, to the value of £27,680 for that purpose; also to make void all claims and demands made, or pretended to be due from this colony, before the first of June, 1714, and to prevent this colony from being in debt for the future." The several sums appropriated, were to be paid in bills of credit, the claimants to accept them in full satisfaction of what was respectively due to, or claimed by them. The bills were to be accepted in all payments of debts, as gold or silver, thereby constituting them a legal tender. The loss of such debt, and a perpetual bar from its recovery, was the penalty for refusing such payment. Any person who should offer to sell any kind of property, and refuse to sell the same unless payment be made in coin, was fined from 40*s.* to £50, and costs, according to the value of the article offered. The bills were not issued before this act. as well as the act laying the excise, was confirmed by her majesty, which was accomplished in June, 1717.

The statute excluded all who were not expressly named therein, from recovering any claim for debts due by the colony, before the 1st of June, 1714, and objections were justly urged against its approval. An explanatory act was therefore passed in 1715, which provided that nothing in the said act, which had excluded *all future demands* whatsoever, should be construed to hinder, bar, or exclude any person having any just claim or demand, from pursuing and obtaining relief.

[1] Sept. 4, 1714, known as the "1st Long Bill."

For the purpose of repairing the fortifications, and for other necessities of government, an act was passed on the 5th of July, 1715, levying duties on certain articles, authorizing the emission of bills of credit to the value of 15,000 ounces of plate, equal to about £6,000, to be current for five years,[1] and to be canceled by the treasurer retaining annually, in the first instance 3,000 oz. of plate from the revenue arising from taxes. It was enforced without the royal approval. The lords of trade refused to submit it to the king, because it seemed repugnant to the act of parliament, settling the rates of foreign coin in the plantations. By the latter act, pieces of eight were not to pass for more than 6*s*., whereas by the New York enactment an ounce of plate was valued at 8*s*. Should the royal approval, said they, be given, the other governments on the continent would immediately do the same thing, and the intent of the act of parliament would be wholly evaded. To which objection the governor replied that the bill was framed after the same manner as to the value of coin, with that for the payment of the public debts, which his majesty, by means of their lordships' recommendation, had approved: that the matter could in no way affect the neighboring colonies, because they had never yet complied with the proclamation. The bills having become widely dispersed before the objections of the lords of trade were communicated, and on account of the bad results which would ensue both to the credit of the colony and to commerce, from a disallowance, it was permitted to lie by, until the expiration of the time fixed for the currency of the bills issued under its authority.

Under the provisions of the law passed in 1715, commissioners had been appointed to adjust and state the several debts still due by the colony. They now laid their account before the assembly. It having been resolved to discharge the whole and to raise such sums as would be necessary for this and other purposes, a law was passed[2] raising and

[1] Afterwards extended to nine years.

[2] Dec. 23, 1717. Known as the "2d Long Bill."

putting into the hands of the treasurer several quantities of plate, and making bills of credit to the value of 41,517 oz., equal to £16,607; and for sinking them a duty of 1¼ oz. of plate was laid on every ton of wine, and 2½ grs. on every gallon of rum, brandy, and other distilled liquors imported for 17 years.

A vigorous remonstrance was made against the passage of this act, by merchant-traders and others, for the most part non-residents of the province, partly from opposition to the excise, and partly from the more general encouragement to trade to the prejudice of the few who has so long monopolized it. An agent was employed to procure, if possible, its disallowance. Gov. Hunter urged his personal protest against their objections to the bill, which he characterized as the most unexceptionable that was ever passed. The lords of trade referred the remonstrance to the lords justices, who reviewing the action of the legislature, and the necessities existing for the currency, were unanimously of the opinion that the act should be confirmed; at the same time recommending that the governor be enjoined not to give his assent to any other bill of this nature, and to transmit semi-annually, accounts of the produce of the funds appropriated for sinking the bills of credit, and the amount of the bills accordingly sunk.

Under the operations of this law, the currency being based on so solid a fund as that of the excise, trade and navigation were favorably affected. The bills of New York were twenty-five to thirty per cent better in New England than their own, being equal to silver, and in some of the neighboring provinces, fifty per cent better.

The administration of Governor Burnet began on the 17th of September, 1720. A supply for five years was granted him, and a law passed[1] directing to be printed forthwith, bills of credit to the value of 5,000 oz. of plate (equal to £2,000). It subsequently appearing that the revenue was insufficient for the large amount of these, and

[1] Nov. 19, 1720.

other bills required annually to be canceled, owing partly to a deficiency in the duties, their currency was continued by later enactments, to Sept. 1, 1733, and in the meantime increased taxes were levied.

In 1723 and 1724,[1] acts were passed "for raising and levying 5,350 oz. of plate (about £2,140), and for striking bills of credit to that value;" also, "for raising and levying the sum of £6,630," mainly for the payment of government charges, the greater part to supply the deficiency in the revenue, which arose from the arrears of fees due to the auditor general; the balance, for promoting a trade with the Indians, which was encouraged by keeping up a constant supply of traders at the public expense.[2] The currency of these bills was restricted to three years.

The trade of the colony at this time was chiefly with Great Britain and the British plantations inthe West Indies, although it extended to Madeira, Curaçoa, Surinam and the French Islands. That to the West Indies was wholly to the advantage of New York, while that to Madeira was to our loss, the province consuming more wine from thence than could be purchased with its commodities. The money imported from the West Indies was not sufficient however to preserve a specie currency, a large amount being necessary to balance the exchange with Great Britain. It seldom remained here long, so that the currency consisted wholly of paper bills and a few Lyon dollars.[3] The value of the former was equal in New York to coin in London, an ounce of Spanish pieces-of-eight being worth but sixpence more than a paper bill of eight shillings, and an ounce of Spanish silver in London being generally worth three or four pence sterling more than the coin.

Many of the bills in circulation, and particularly those

[1] July 6, and July 24.

[2] *Col. Docs.*, v. 701.

[3] *Col. Docs.*, v, 686.

of the smaller denomination became in time so defaced and torn as to be illegible and almost worthless. On four separate occasions[1] therefore, new issues amounting to £19,000 were made and lodged in the state treasury to be exchanged for bills of this description. The preamble of the act of 1726 cites, that the service of signing these reissues was to be *gratuitous*.[2] These bills are distinguished from the others by an oval blank at the top, in which the date of the original bill is written.

For the space of ten years (1724 to 1734) no new bills of credit were created excepting those last described. In the spring of 1734 the governor recommended several measures for putting the colony in a better state of defence. The position of affairs in Europe indicated a rupture between England and France. With a view to these contingencies he urged the erection of proper fortifications on the frontiers, and in the harbor of New York.

His suggestions met the approval of the legislature, and after a long preamble citing the various causes which had heretofore called for the issue of paper money, and assuring the public that the credit of the colony was still unimpaired, that the campaign in Canada could not have been carried on without the help of a paper credit, and that it would be impracticable to fortify the colony unless the same expedient was made use of, it was enacted[3] that bills of credit to the value of £12,000 should be printed and lodged in the treasury.

This measure much gratified his excellency who hoped by the patronage it carried, to weaken the opposition which was then existing. The standing instruction from the king required however, as has been already stated, a clause in every bill, suspending its operations until his majesty's

[1] July 24, 1724, £3,000; Nov. 11, 1727, £3,000; Oct. 17, 1730, £3,000; Oct. 25, 1739, £10,000.

[2] An allowance of £8 was usually made for numbering and signing the bills.

[3] Nov. 28, 1734.

approval could be known. In order that none of the governor's aims should be thwarted, his friends in the council induced the house to appoint a committee to meet them and prepare an address requesting him on account of urgent necessity to pass the bill. It was immediately prepared, and on the next day presented and passed, but not without opposition.

The bills issued by this act, were to be current for twenty-two years, and to be canceled by a duty on tonnage of goods, and a tax on slaves.

Trade had for some time been on the decline. Merchants having the means, chose rather to make loans at eight per cent, which was considered an excessive rate, than to engage in commerce. Besides, imports were considerably taxed, being charged with almost the whole support of government.

The merchants suggested a tax on lands, but the members from the country being in the majority, prevented the adoption of such a plan. There was a disposition to increase the currency by a new emission of paper money, but the great poverty of the province and its inability to bear further taxation was given as the excuse. The opposition was made in reality by the moneyed interest, for it was generally understood that it was postponed to create a *loan* at a lower rate of interest than money commanded.[1]

The spring session of 1737 found the province involved largely in debt which had arisen from an insufficiency of former revenues. Amounts were due the late governor, the chief justices and other officers, for salaries, to the amount of about £9,000. The lieut. governor, who was then acting, urged the immediate attention of the house to the matter, intimating that unless aid was provided, the people would have an opportunity of electing new

[1]The present legal rate of interest (7 per cent) was established by law in 1738. It was proposed in the assembly, to make it 6 per cent, but the council altered it to 7.

representatives. After waiting about a month for their favorable action and no relief tendered, he summoned them to his council chamber, and in a short speech dissolved them.

The new assembly had a spring session of only a few days. At its reopening in the fall, the lieut. governor again commended an honorable revenue for the support of the government. This session, which was a long one, resulted in the passage on its last day,[1] of an act emitting bills of credit to the amount of £48,350, which was a consequence unanswerable to the late election. Still, the assembly wishing to place itself as not countenancing prodigality, assured his excellency that he was not to expect that they either would raise sums unfit to be raised, or put what they should raise in the power of the governor to misapply if they could prevent it; nor would they make up any other deficiency than they should conceive fit and just to be paid, or continue what support or revenue they should raise for any longer time than *one year*. Much to the annoyance of the governor, they did not omit to act up to their determination, and the system thus inaugurated was continued by subsequent assemblies, although every argument was employed to induce a return to the former custom of granting supplies for five years.

This law was different from any of the preceding in several important particulars. As it contemplated an increase of the circulating medium, which had become quite reduced,[2] the currency of the neighboring colonies having become the chief medium of trade, the sum of £40,000 was reserved as a *loan*, to be distributed among the several counties in the following proportions:

New York, ...	£10,000	Kings, ...	£2,400
Suffolk, ...	3,000	Richmond, ...	1,600
Dutchess, ...	2,000	Orange, ...	2,000
Albany, ...	5,000	Ulster, ...	4,000
Queens, ...	6,000	Westchester, ..	4,000

[1] Dec. 16, 1737. The act was known as the "Loan Bill."

[2] Small change was so scarce that coppers were imported from England as a profitable speculation.—*Col. Docs.*, VI, 117.

the interest of which was annually applied to the support of government. The office of "loan commissioner" was created, and the commissioners were required to loan the amounts thus apportioned on the security of mortgage on real estate, at an annual interest of five per cent, for the term of twelve years, in sums not to exceed £100, nor less than £25. They were also authorized to loan sums for one year, on the security of good plate at six shillings per ounce. At the expiration of the time allowed for the circulation of these bills, they were to be returned to the treasurer, and canceled. The sum of £8,350, appropriated for the payment of government debts, was to be sunk in part by certain taxes due from several counties, and the balance from interest accruing on the £40,000 loan.[1]

The currency of the bills emitted in 1714 and 1717, amounting to £44,287 was now soon about to expire. About one half of the amount was still in circulation. Gov. Clark, well aware that the assembly would attempt to extend the term, as well as the excise act, for a sufficient number of years to allow of the extinction of the bills, endeavored to force the house to abrogate the system of yearly supplies for the support of government, as well as the special application of the funds. He perceived the necessity the assembly would be put to, and repeatedly assured the lords of trade that he would on no consideration yield until he had "brought them to their senses." He intimated to the legislature, therefore, that he would pass no bill allowing such an extension, unless a supply for at least five years was granted; whereupon the house resolved not to pass even the *annual* supply bill, without assurances that the paper money of the dates above mentioned, and the excise bills, should be continued for some years. Clauses were attached to the supply bill to this effect, and a committee appointed to inform the governor of their action.

[1] The bills of 1734 of the denomination of 10 and 5 shillings, and of 1737 of the denomination of 40 shillings, were counterfeited in Ireland.

The next day he summoned the assembly, and reviewing their action, informed them that they had taken such "presumptuous, daring, and unprecedented steps," that he could not look upon them without astonishment, nor with honor suffer them to sit any longer.

Writs for a new election were issued returnable on the 27th of March 1739. Scarcely a week elapsed from the opening of the session before the bill which had occasioned the late rupture was introduced, considered soon after, and passed. Apprehending that it might not receive the governor's approval, the assembly passed a resolution to support the credit of the paper emissions of the colony, and especially those of 1714 and 1717 declaring at the same time, that they did not doubt but that future assemblies would do the same. The lieut. governor, highly indignant, at once prorogued this body also with the following speech:

"Gentlemen:—I come to put an end to this session, and to give you a short recess. I was in hopes, and I believe every reasonable man expected that at this juncture you would seriously have laid to heart the true interests of your country by showing your duty and loyalty to his majesty in supporting his government in an honorable manner."

The prorogation was for one week. The day following their reassembling, the bill entitled "An act further to continue the duty of excise and the currency of the bills of credit emitted thereon," was read a second time (having been introduced and read on the previous day) and committed to a committee with instructions to add clauses for the emission of new bills of credit to be exchanged for those which had become torn and defaced. It went rapidly through the two houses, and on the 25th of October, 1739,[1] received the lieut. governor's *assent*, with this brief

[1] The bills emitted by this act have been already alluded to — see p. 22.

message: — "I am come to give my assent to the bills that are ready for it, as the highest instance I can give of my care for the credit and welfare of the colony, and the confidence I have in your honor."

The reverse in the governor's determination was induced by several circumstances. He was convinced that the country was quite unanimous in approving the course of the assembly, and that a new election would only result, as it had already, in the return of men not otherwise minded than their predecessors. Again, there were appearances of a rupture between England, France and Spain, and he wished to avail himself of the assembly's present sitting, to place the province in a proper state of defence; and finally, because the assembly had become still more resolute in their intentions, from a recent example in the province of New Jersey, where the governor had given his consent to a revenue bill whereby the money was all *specially* applied.[1] To these reasons should be added, personal necessities, the usual supplies having been so long withheld that the governor had even sold some of his estates to enable him to support the government.[2] He apologized to the lords of trade for his unexpected action, on the ground of the precedent set in New Jersey, but asked their favorable allowance of the bills on account of the feeling existing in the province, assuring them that he had thereby secured a greater state of quiet than had been known for forty years before.

On the representations of London, Liverpool and Bristol merchants, in June, 1739,[3] a series of resoluions were introduced in parliament, praying his majesty that an account might be prepared of the rate at which gold and silver

[1] In former acts no applications had been made of the funds, except for the salaries of treasurer and members of assembly: — the remainder being generally appropriated "for the support of his majesty's government."

[2] *Col. Docs.*, VI, 160.

[3] House of Common's Journals.

coins were taken and paid in any of the British colonies in America; also of the amount of paper bills issued in any of said colonies since the year 1700, the provisions made for sinking them, and the amount canceled: to which resolutions, the commissioners of trade and plantations responded,[1] laying before parliament returns quite full, which had been received in answer to inquiries, from eleven of the colonies.

The proceedings excited the attention of most of the provinces, and their agents in London were instructed to petition the house of commons for a hearing in the matters referred to, and to use their best endeavors to procure the postponement of any unfavorable bill. The subject was temporarily disposed of by declaring that the instructions of his majesty, and the laws of parliament, regarding the rates of foreign coins in the plantations had not been observed. The instruction was renewed not to allow any bill to pass, whereby bills of credit might be issued in lieu of money, without a clause inserted declaring that the act should not take effect until approved by the king.

It has been already noticed that these instructions were not strictly enforced in the colony of New York, and the same was probably true in respect to other colonies; accordingly in 1744 the complaint was renewed that large emissions of bills of credit had been made, notwithstanding the "instructions," and that more were intended. Whereupon leave was granted to bring in a bill to prevent the issuing of paper bills of credit in the British colonies and plantations in America, to be legal tenders in payments of money, which bill having had its first reading was indefinitely postponed.

No public measures were taken in the general assembly of New York to controvert these proceedings in parliament, but her interests were nevertheless well cared for. It had been rumored in the assembly before the conclusion

[1] March 28, 1740.

of the fall session of 1745, that such a measure was before the house of commons. The credit of our bills was quite unimpaired and it was not conjectured that any objections could be urged against them in parliament. No copy of the bill under consideration had been seen here, and it was not until after the adjournment when one was borrowed from a neighboring colony, that the last clauses which were especially offensive, were fully comprehended. Indignation was at once aroused in every mind, for to use the words of the committee, "If all the parts of the legislature in every colony and plantation should be obliged and enjoyned (as by the said clauses are directed) to pay strict obedience to such orders and instructions as should from time to time be transmitted to them or any of them by his majesty or his successors, or by or under his or their authority, it would establish such an absolute power in the crown, in all the British plantations, as would be inconsistent with the liberties and privileges inherent in a Englishman whilst he is in a British dominion."

Without delay a meeting of several members of the council and merchants resident in New York was called, and it was determined not to allow such measures to go through parliament without at least a protest. Funds were advanced to employ a solicitor and counsel in London to oppose the bill before the committee of the house of commons. The general assembly at its next session fully recogznied these proceedings, officially acknowledging the services of the agents, and refunded the amounts advanced for their services.

To defray the expense of carrying on the war against the French and Indians, in conjunction with the Eastern colonies, a law was passed in 1746 (May 3) to raise a supply of £13,000 by a tax on estates real and personal, and to emit bills of credit for the like sum. The amount was to be canceled in three years by an annual tax, in the proportion indicated in the following table:

New York,.....	£1,444	8*s.*	11*d.*
Albany,.....	622	3*s.*	9½*d.*
Kings,.....	254	18*s.*	0½*d.*
Queens,.....	487	9*s.*	5½*d.*
Suffolk.....	433	6*s.*	8*d.*
Richmond,.....	131	6*s.*	3½*d.*
Westchester,...	240	14*s.*	8½*d.*
Ulster,.....	393	18*s.*	9½*d.*
Orange,.....	144	8*s.*	10½*d.*
Dutchess,.....	180	11*s.*	11½*d.*

A new issue was soon after made, and for the same purpose. The colony's funds had been anticipated and exhausted, and a heavy tax remained unpaid. To use the language of the assembly, "it was constrained, but with the greatest regret," to make a further issue at this time.

A scheme for the conquest of Canada was again brought forward. Orders had been sent over by the British government directing the colonies to raise as many volunteers as the time would permit, to join the regular forces from England. The governor recommended that the most ample provision should be made and in the most speedy manner. The assembly perceiving that the movement was popular with the people, seconded most enthusiastically the demand for men and means. "Willing rather to exceed than to fall short in supplies on this important occasion" they promptly enacted,[1] that the sum of £40,000 should be raised by an annual tax of £5,000 on real and personal estate, and that to answer the immediate payment of the sums required, bills of credit to the full amount should be issued. This amount proving insufficient, the following year,[2] another act was passed, creating £28,000 to be paid by a yearly tax of £3,500.[3]

[1] July 15, 1746.

[2] Nov. 25, 1747.

[3] Bounties were raised for volunteers, and the exportation of provisions suspended. The neighboring Indians also were incited to aid in the enterprise.

Circumstances growing out of the control and disbursement of these funds, occasioned controversies to which in point of bitterness, modern political warfare affords no parallel. The assembly assumed the right of judging of the necessities of the colony, and moreover took advantage of the demands and actual necessities of the government to secure for their own friends positions of power and influence. Governor Clinton, anxious to carry out the wishes of his government, was compelled to make concessions, and explanations of the manner in which funds and provisions previously granted had been applied. The bill was passed, but the distribution of the means for carrying on the expedition was intrusted to commissioners.

The governor, on the advice of the council, assented to the act notwithstanding the opposing "instructions," because the extraordinary occasion seemed to require it, and then dissolved the general assembly. In his letter to the lords of trade of this date, he recounts his grievances, and deprecates the growing power of the assembly, and suggests as a remedy the repeal of the acts issuing bills of credit and reissuing these bills under such conditions as his majesty should think proper.

This disagreement between the governor and general assembly continued for several years. The former attempted a restoration of the appropriation of supplies for the government for five years as in the times of Hunter, Burnet, &c., which was successfully resisted by the latter, as were efforts to reinvest the governor with certain privileges now claimed by the assembly. On a subsequent occasion the treasurer refused to furnish the governor with a statement of the accounts of the colony or of the bills of credit, in order to enable him to respond to a demand from the crown.

Between the years 1748 and 1752 there was peace between France and England. The long contests for pos-

sessions in America had resulted partially favorable to the latter. Vast amounts of money had been expended by the colonies for the honor of the crown. New York alone had contributed up to this time more than £81,000 without demanding or receiving any reimbursement,[1] as had been the case in some of the other colonies. The amount which she had issued since the commencement of the bills of credit system, although quite large, had not yet brought about the disastrous consequences which had befallen some of the neighboring provinces where proper precautions for canceling had not been taken. The emissions and rëemissions in Massachusetts alone from 1702 to 1740 amounted to £1,442,500, and at the latter date £230,000 were still outstanding. Its depreciation was alarming. In 1700 the colonial pound was worth $2.90 of Massachusetts money; in 1727, $1.48; in 1734, 91 cents; in 1738, 78 cents, was finally reduced to $\frac{1}{10}$ of a pound sterling.[2] In respect to the colonies in general, the following table exhibits the rate of exchange for £100 sterling at two different periods.

	1740.	1748.
New England,	£525,	£1,100,
New York,	160,	190,
New Jersey,	160,	180, & 190,
Pennsylvania,	170,	180,
Maryland,	200,	200,
North Carolina,	1,400,	1,000,
South Carolina,	800,	750,
Virginia,	——	120, & 125.

The result of unsafe and extravagant issues in the eastern provinces was the passage of an act by parliament in 1751, regulating and restraining paper bills of credit in Rhode Island, Connecticut, Massachusetts and New Hampshire, and preventing the same from being a legal

[1] Two small grants were subsequently made by the British parliament.

[2] *Essex Inst. Hist. Coll.*, I, 128.

tender.[1] The enactment forbade the use of such money except for yearly government expenses, and in case of invasion, and not at all as a legal tender for debts. Any governor who should sanction a law having a different signification should be deprived of his office, and ever after be ineligible to public employment.

The interim of peace between England and France afforded an opportunity for maturing new projects for conquest in America. France having no frontier coast, set about consummating a plan to possess the St. Lawrence and the Mississippi, and to establish a line of forts through the interior of the country. These operations were looked upon as encroachments, and on the complaint of the Ohio company, whose province had been trespassed upon, Governor Dinwiddie, of Virginia, called for desistance. An unsatisfactory return having been received, a regiment was immediately raised and marched to the disputed territory.

Towards defraying the expense of this expedition New York advanced £5,000. The French were not unsuccessful and war was considered again commenced.

Three operations were decided upon: the first, an attack on Fort du Quesne, the second on Fort Niagara, and the third on Crown Point. The governor requested means to build another fort on the Hudson, and additional fortifications on the frontiers. But under the provisions of the late act of parliament any new issue of paper money was forbidden. Taxation was already oppressive, and a strong feeling existed against any further burden of this nature. These circumstances, said the general assembly, "render it impracticable for us to raise such further sums as appear necessary, in any other manner than by paper emission. But to emit bills of credit without making them a lawful tender we are confident will be

[1] Gough on Banking.

absolutely useless, and without effect, for we are fully persuaded that no man in the province will be willing to accept that for money which he knows that another may refuse to receive as money from him, and if a law even under this restriction must have its execution suspended till his majesty's pleasure can be known, this his majesty's loyal colony may fall a prey to some ambitious, avaricious enemy before any return can be made." In answer to which objections the governor recommended the legislature to pass a law with the suspending clause, "the bills to be declared not a legal tender for debts contracted in Great Britain." The house refused to adopt his suggestion, and an adjournment was made. In the meantime advices were received from England, a proclamation for reassembling was issued, and soon after hearing and considering the governor's speech a bill was introduced and subsequently passed,[1] raising by tax £45,000, issuing for immediate use bills of credit for the like amount. They were put on the same footing as other bills of the province, and their currency continued until November, 1761.

The disastrous campaign of 1755-56 now opened. As a preliminary, Forts Beausijour and Gaspareau in Nova Scotia, were taken by some eastern troops, thus subduing the French in that province, but a succession of defeats followed, which more firmly established the French domination in America. The expedition against Fort du Quesne was a failure. Fort Edward was lost, as were Forts Granby and William Henry. Forts George and Oswego were taken and demolished. The only defeat of the opposing forces was that at Lake George. The plan for connecting the northern and southern possessions by a line of forts succeeded, and the French now held undisturbed possession of all the country west of the Alleghany mountains.

[1] Feb. 19, 1755.

In prosecuting this campaign heavy drafts were made on the resources of New York. Paper money enactments followed each other in rapid succession. Besides the amount authorized on the 19th of February, ten thousand pounds were issued May 3d, eight thousand pounds September 11th, ten thousand pounds April 1,1756, and fifty-two thousand pounds additional at the same date. This addition of £125,000 to the debt of the province in two years, affected materially the character of the currency, and created some alarm in the general assembly. Unable to cancel the bills as they became due, they were repeatedly extended. A committee of the house was instructed to bring in bills "for establishing a stamp office on vellum parchment and paper which should be charged with duty," and another "for laying an excise on all teas of foreign growth which should be sold by retail in the colony." Both measures were adopted.

The losses and disappointments of the last campaign greatly discomforted the crown and parliament of Great Britain, and their pride and courage arose in proportion. Mr. Pitt had just been placed at the head of a new ministry, and his active spirit invigorated all with whom he became engaged. In a circular to the colonial governors he informed them of his majesty's determination to send a large force to America to operate against the French, and called upon them to raise as large a force as possible.

However much the provinces may have been disheartened and borne down by previous misfortunes, their sympathies seemed at once engaged. To the call the general assembly of New York responded as follows: "With the utmost satisfaction we receive his majesty's directions for making an irruption into Canada, and we cannot entertain the least doubt that every colony on the continent will most heartily coöperate with, and second his majesty's intentions by a vigorous exertion of their utmost strength."

They agreed without hesitation to make effectual provision for levying, clothing, and paying such a body of troops as the number of inhabitants would allow. The plan was to raise 20,000 provincials, the king furnishing arms, ammunition, tents, and provisions. The number apportioned to New York was 2680 men, for the clothing and paying of whom £100,000 were emitted[1] in paper money, to be canceled by a nine years' tax.

The struggle then began, and its results are matters of well known history. Success attended it through. It commenced by taking from the French, Louisbourg, then Fort Frontenac and soon after Fort du Quesne. Fort Stanwix was built, and Ticonderoga taken. The French were again defeated at Niagara, the fort taken, and finally Quebec fell.

Further appropriations were called for as the war advanced. A second issue of £100,000 of bills was made in 1759,[2] to be canceled with the last, and in the same year[3] the sum of £150,000 was, at the request of Gen. Amherst, advanced to the British contractor's agent in America for supplying the army, for the immediate payment of which, paper money was emitted, on the credit of sets of bills of exchange drawn at 60 days, for 375,000 Spanish milled dollars. In 1760[4] the sum of £60,000 in further payment of the expenses of the 2,680 men was added to the amount already issued, making a total of £410,000.

The amount of paper money in circulation had become large. In some of the colonies, and indeed in New York, the provisions for canceling as the bills matured, were not always adequate. It was ascertained upon an examination by a committee of the general assembly, that above £600 which should have been redeemed, were still

[1] March 24, 1758.
[2] March 7th.
[3] July 3d.
[4] March 22.

in circulation. In some of the neighboring provinces such neglect was so serious as to constitute one of the chief causes of depreciation, and was likewise the occasion of frequent and urgent complaint by British creditors. The agent of New York informed the general assembly that upon the complaints of divers merchants trading in Virginia, the lords commissioners of trade and plantations seemed determined to adopt the plan of the act passed during the reign of the late king, for regulating and restraining the paper currencies of New England, and to propose that the same should be extended over all the other colonies of North America. Despite our remonstrances against such a proceeding, parliament passed "an act to prevent paper bills of credit hereafter to be issued in any of his majesty's colonies or plantations in America from being declared to be a legal tender in payment of money, and to prevent the legal tender of such bills as are now existing from being prolonged beyond the periods limited for calling in and sinking the same."

The New York assembly, through their agents in England and Governor Moore, applied to the crown to have these restrictions removed, because the bills then in circulation would be sunk in 1768, and the country left without any medium for commerce, there being but little silver, on account of the interruptions of the Spanish trade. Governor Moore wrote also to the lords of plantations requesting instructions as to how far he might be authorized to give relief to the people in this case, so as to put them upon a footing with the neighboring colonies where the circulation of the paper credit was extended to more distant periods. The latter recommended that the governor be released from the restriction of not assenting to any law for issuing paper bills of credit whatever; that if found necessary a further sum of £250,000 might be issued under proper regulations and restrictions, but they refused to remove the

restrictions of the legal tender, as that could not be done without the interposition of parliament.

The only currency that had up to this date been made a legal tender in the province of New York, consisted of Lyon dollars, and the paper bills of credit.[1] The former at this date (1768) were rarely seen, and the currency of the bills already issued would expire, as above stated, in the fall of 1768, after which time therefore there would be no legal tender. To relieve this serious difficulty, the general assembly passed an act making gold and silver coin a legal tender, fixing no value other than that for which they passed current in the common course of business; but as this would conflict with an act passed in the 6th of Anne, in regard to the value of different species of money, the governor refused his assent. Debtors became exposed to the malice of their creditors, and a clamor soon arose which induced the assembly, notwithstanding the recent act of parliament, to pass a law emitting apper money to the amount of £120,000. It was similar to the preceding, except in one or two particulars. First, it was not to take effect until after the 1st of Nov., 1769, which would afford an opportunity to submit it for royal approval. Secondly, the interest of five per cent was to be paid on the whole capital for the first four years, and in the fifth year one tenth part of the capital to be sunk, and continued in the same proportion every succeeding year. To this act, on the petition of the assembly and council, the governor gave his assent; first, because the money could not be disposed of without the concurrence of the governor and council, and secondly, because it had the effect of establishing a revenue for a number of years, an approach to a luxury which had not been recently enjoyed, and it was thought best not to despise it. The royal approbation was, on the same grounds, strongly urged in

[1] The bills of the neighboring colonies were never made a legal tender in New York.

its behalf. There was some delay in responding to the communication of Governor Moore, and in the meantime Lt. Governor Colden succeeded to his office. He urged an approval of the measure which the assembly seemed to "have much at heart," stating that unless it was granted it would be difficult to make them continue the provision for the soldiers quartered in the province, after Massachusetts and South Carolina had both absolutely refused to do it. Having waited more than a year for the assent of the king, a new bill was introduced and passed, similar in its provisions with the last *without* the suspending clause, but providing that the bills should not be issued before the first of June following. There was a disposition to avoid all legislation of a public nature until the governor should give his assent to this bill, which he accordingly did, and for which he was afterwards severely reproved. The committee of the privy council, to whom both bills had been referred, reported unfavorably, and they were finally rejected on account of their inconsistency with the late act of parliament relating to legal tenders. An intimation was at the same time held out that parliament would probably pass a law enabling the legislature of New York to carry into execution the law for which they seemed so desirous. Such an act was passed the same year.[1]

In the fall of 1770 the £120,000 bill was again introduced, amended, and passed on the 16th of February following.[2] The money was loaned among the several counties for 14 years, at five per cent.

[1] An act to enable the governor and council and assembly of his majesty's colony of New York to pass an act of assembly for creating and issuing upon loan, paper bills of credit to a certain amount, and to make the same a legal tender in payment into the loan offices and treasury of the said colony.

[2] These bills were extensively counterfeited, so that a law was passed in 1773 substituting new bills. The matter of devising suitable devices, &c.,

The general assembly continued its sittings until April 3d, 1775, when the country was in a state of revolution. The provincial congress of New York which succeeded the general assembly, arose out of a recommendation of the continental congress for each colony to organize a government for itself. It assembled on the 20th of April, 1775, and continued the government of New York during that period, and its resolutions and orders constituted our laws. In conducting the great struggle of the revolution, it experienced in common with other provinces and the continental congress the exceeding difficulty of procuring money for the subsistence of a suffering army.[1] Early in its session a committee was appointed to take into consideration the expediency of emitting a paper currency, which committee immediately prepared and presented (May 30, 1775) an elaborate report.

The conclusions formed were, that there was a smaller amount of gold and silver in this colony than in several others, and that it would be impossible to collect a sufficient sum without issuing a paper curreney of some sort. Three modes were proposed by which it could be issued. First: that every colony should strike for itself the sum apportioned or to to be apportioned by the continental congress.

Second: that the continental congress should strike the whole sum necessary and each colony become bound to sink its proportionate part.

Third: that the continental congress should strike the whole sum and apportionate the several shares to the

was referred to a committee. In the assembly the following was proposed: "an eye in a cloud, — a cart and coffins, — three felons on a gallows, — a weeping father and mother with several children, — a burning pit, human figures forced into it by fiends, and a label with these words — Let the name of the money maker rot." The penalty of the law — capital punishment, was in several cases carried out. *See* papers of that date.

[1] During the Revolution our revenue officers were in the hands of the British.

different colonies, every colony becoming bound to discharge its own particular part, and all the colonies to discharge the part which any particular colony should be unable to pay.

The first proposition was disapproved of because the money issued would not have a general credit; the second was objectionable because default might be made by some of the colonies in sinking the amount assigned to it. The third was conceded to have the advantage of a higher and more general credit than either of the former, and the convention on the recommendation of their committee adopted it, and instructed our delegates in congress accordingly. The plan was not adopted by the continental congress, and the provincial congress resorted to an issue of £45,000 on the 2d of Sept., 1775, other issues followed increasing the amount to £300,000.[1]

Concerning the precise objects for which these sums were appropriated it is not necessary to make an account. The country was flooded with the emissions made by the several colonies and by the continental congress, and the evils produced were incalculably great. The country was unable to redeem its currency and the depreciation was ruinous. The whole amount issued in New York from 1709 to the last issue in 1786 was not large, and the special and repeated methods of taxation adopted for its extinction were as successfully carried out as the resources of the country would allow.

In 1781 an act was passed establishing the rate of depreciation of continental bills of credit, in the settlement of accounts.[2]

After the adoption of our state constitution in 1777, only two laws were passed making bills of credit; one in

[1] May 5, 1776, £55,000; Aug. 30th, 1776, £200,000. In 1799 an act was passed canceling all bills issued by this congress of the denomination of one dollar and under.

[2] See table at the end of this work.

1781,[1] for $411,250 to pay the proportion called for by congress towards the expenses of the war, and the other in 1786,[2] for £200,000 to be loaned at 5 per cent, for the purpose of increasing the currency.

The bills of the provincial congress as well as the continental bills were made a legal tender,[3] but in 1781 an act was passed, repealing all laws making bills of credit a legal tender, and four years later, all such bills in the state treasury were destroyed.

A Catalogue of the Bills of Credit issued by New York from 1709 *to* 1789: *with a description of the bills, the dates, denominations and signers.*

1709.—June 8.

Amount, £5,000.

Form: This indented Bill of.....Shillings due from the Colony of New York to the Possessor thereof, shall be, in Value equal to Money; and shall be accordingly accepted by the Treasurer of this Colony, for the time being, in all publick payments; and for any Fund at any Time, in the Treasury. Dated, New York, Thirty-first of May, One Thousand Seven Hundred and Nine; by Order of Lieutenant-Governor, Council, and General Assembly, of the said Colony.

Signed by Lawrence Reade, Robert Walters, John Depeyster, and Robert Lurting, or any three of them.

[1] March 27.

[2] April 18th.

[3] Made so in 1780 at the rate of 8*s.* to the dollar. The money of account of the U. S., that is to say, the dollar, dime, cent, mill, was adopted in New York by an act passed Jan. 27, 1797, by providing that a dollar should be 4-10 of a pound, a dime 1-10th, &c., &c.

Description: Indented at the top,—dated,—the arms of the city of New York on the left side, towards the bottom.

Number and division of the bills:

400 bills, each of £5.		
600	do.	40 shillings.
600	do.	20 do.
1,000	do.	10 do.
2,800	do.	5 do.

Currency limited to May 31, 1711.

Commissioners for canceling, the signers and treasurer.

Number canceled not known.

1709.—November 1.

Amount, £4,000 or 14,545 Lyon dollars.

Form: This indented Bill of.....Shillings, due from the Colony of New York to the Possessor thereof, shall be in Value equal to Money, and shall be Accepted accordingly by the Treasurer of this Colony for the time being, in all Publick Payments, and for any fund at any time in the Treasury. Dated, New York the First of November, 1709, by order of the Lieutenant Governor, Council, and General Assembly of the said Colony.

Signed by Robert Walters, John De Peyster, Robert Lurting, and Johannes Jansen, or any three of them.

Description: The same as of June 8.

Number and division of the biils:

400 bills, each of £5.		
400	do.	50*s*.
800	do.	25*s*.

Currency limited to Nov. 30, 1712.

Commissioners for canceling, the signers and treasurer.

1709.—November 12.

Amount, £4,000 or 14,545 Lyon dollars.

Form: This indented Bill of.....Ounces of Plate, or.....Lyon dollars, due from the Colony of New York

to the Possessor thereof, shall be, in value, equal to Money; and shall be accepted accordingly, by the Treasurer of this Colony for the Time being, in all publick Payments; and for any Fund, at any Time, in the Treasury. Dated in New York, the first Day of November, One Thousand Seven Hundred and Nine, by order of the Lieutenant Governor, Council and General Assembly of the said Colony.

Signed by Robert Walters, Robert Lurting, Johannes Depeyster, and Johannes Jansen, or any three of them.

Description: The same as of June 8.

Number and division of the bills:

300 bills, each of 20 Lyon dollars.			
300	do.	16	do.
300	do.	8	do.
337	do.	4	do.

Currency limited to Feb. 28, 1713.

Commissioners for canceling, the signers and treasurer.

1711.—July 26.

Amount, £10,000.

Form: This indented Bill of.....Coyned Plate, due from the Colony of New York, to the Possessor thereof, shall be in Value equal to money, and shallbe accepted accordingly, by the Treasurer of this Colony, for the time being, in all publick payments, and for any fund in the Treasury. Dated in New York the 20th Day of July, 1711, by order of the Governor, Council and General Assembly of the said Colony.

Signed by Robert Walters, Robert Lurting, John Depeyster.

Description: Dated, and indented at the top, the arms of the city of New York on the right hand side towards the bottom.

Number and division of the bills:

500	bills,	each of 20	ounces of plate.
500	do.	10	do.
1,000	do.	5	do.
500	do.	2½	do.
1,000	do.	2	do.
1,000	do.	1	do.
1,000	do.	½	do.
1,000	do.	¼	do.

Currency continued to 1724.

Commissioner for canceling, the treasurer.

1714.—September 4.

Amount, £27,680.

Form: This indented Bill of..... Ounces of Plate or.....due from the Colony of New York, to the Possessor thereof, shall be in Value equal to Money, and shall be accepted accordingly, by the Treasurer of this Colony for the Time being, in all publick Payments, and for any Fund at any time in the Treasury. Dated in New York, the first day of July One Thousand Seven Hundred and Fourteen, by Order of the Governor, Council and General Assembly.

Signed by Robert Walters, Robert Lurting, David Provoost, and John Cruger, or any three of them.

Description: Impressed on the left side, about the middle of the side, the arms of the city of New York; the quantity of plate and the value of the same printed at the top.

Number and division of the bills:

568	bills,	each of	£10.
500	do.	do.	7 10*s.*
700	do.	do.	6.
720	do.	do.	5.
1,000	do.	do.	3.

568 bills, each of £10.
800 do. do. 2 10*s.*
800 do. do. 1 10*s.*
1,000 do. do. 1 5*s.*
1,200 do. do. 15*s.*
1,500 do. do. 15*s.*
2,000 do. do. 6*s.*
4,000 do. do. 3*s.*

Currency continued to Dec. 31, 1739.
Commissioners for canceling, the signers.
Amount canceled, £27,406 8*s.* 0*d.*

1715.—July 5.

Amount, £6,000 or 15,000 oz. of plate.
Form: Same as last, excepting the date.
Signed by Robert Walters, John Cruger, David Provoost, John Read, or any three of them.
Description: Same as last.
Number and division of the bills:

200 bills, each of £10.
200 do. 5.
200 do. 4.
200 do. 2.
1,000 do. 20*s.*
1,000 do. 10*s.*
1,200 do. 5*s.*

Currency continued to July 1, 1724.
Commissioners for canceling, the signers.

1717.—December 23.

Amount, £16,607 or 41,517½ oz. of plate.
Form: This Bill of ..... ounces ..... Penny-Weight of Plate, due from the Colony of New York to the Possessor thereof, shall be in Value equal to Sevil, Pillar, or Mexico Plate, and shall be Accepted accordingly by the Treasurer of this Colony for the time being, for

all Publick Payments, and for any Fund at any time in the Treasury. Dated in New York, the twenty-eighth Day of November, One Thousand Seven Hundred and Seventeen, by Order of the Governor and Council and General Assembly.

Signed by Robert Walters, Johannes Jansen, David Provoost, John Cruger, or any three of them.

Description: Impressed in the middle with the arms of the city of New York, and at the top of each, the quantity of plate represented.

Number and division of the bills.

1,391	bills,	each of	10	oz.	of	plate.
1,000	do.	7	" 10	pwt.		do.
1,000	do.	5	"			do.
1,000	do.	2	" 10	"		do.
1,000	do.	2	"			do.
1,000	do.	1	" 10	"		do.
1,000	do.	1	" 5	"		do.
2,200	do.	1	"			do.
3,000	do.		15	"		do.
4,000	do.		10	"		do.
5,630	do.		5	"		do.

Currency limited to 1740.

Commissioners for canceling, the signers.

Amount canceled, £16,351.

1720.— November 19.

Amount, 5000 ounces of plate or £2,000.

Form: This indented Bill of.....Pennyweight..... Grains of Plate, due from the Colony of New York to the Possessor thereof, shall be in value equal to Plate, and shall be accordingly accepted by the Treasurer of this Colony, for the time being, in the Treasury, Dated in New York, the tenth day of November, One Thousand Seven Hundred and twenty; by order of the Governor, Council and General Assembly.

Signed by David Provoost, John Jansen, Jacobus Kip, Gerardus Beekman or any three of them.

Description: Impressed on the right side, about the middle of the side with the arms of the city of New York.

Number and division of the bills:

6,001	bills,	each of	2	pwt.	12	grs. of plate.
4,000	do.		3	"	18	" do.
4,000	do.		6	"	6	" do.
4,000	do.		7	"	12	" do.
1,714	do.		8	"	18	" do.

Currency continued to Sept. 1, 1733.

Commissioner for canceling, the treasurer.

Amount canceled, £1,896 8*s.* 6*d.*

1723.— July 6.

Amount, £2,140 or 5,350 ounces of plate.

Form: This indented Bill of ..... Ounces, and ..... Pennyweight of Plate, due from the Colony of New York to the Possessor thereof, shall be in Value equal to Plate, and shall be accordingly accepted by the Treasurer of this Colony for the Time being, in all publick Payments, and for any Fund at any time in the Treasury. Dated in New York, the second Day of July, One Thousand Seven Hundred and Twenty-three; by order of the Governor, Council and General Assembly.

Signed by David Provoost, Johannes Jansen, Jacobus Kip, John Cruger, Gerardus Beekman, or any three of them.

Description: Impressed on the middle, with the arms of the city of New York, and on the top of each, the quanity of plate represented.

Number and division of the bills:

243	bills,	each of	11	oz.	5	pwt. of plate.
299	do.		8	"	15	" do.

Currency limited to July 1, 1726.

Commissioners for canceling, the treasurer and signers.
Amount canceled, £2,122 10*s.* 0*d.*

1724.—July 22.

Amount, £3,000.

Form: This indented Bill, due from the Colony of New York, to the Possessor, shall pass current in all Payments, for ....., conformable to Law made by the Governor, Council and Assembly of the said Colony, Dated the Twenty-second Day of July, One Thousand Seven Hundred and Twenty-four.

Signed by David Provoost, Johannes Jansen, Jacobus Kip, John Cruger, Gerardus Beekman, or any three of them.

Description: Impressed on the right side with the arms of the city of New York; at the top, bottom and each side, the value of each bill, an oval blank at the top with the date of bill substituted.[1]

Number and division of the bills:

800	bills, each of	12	shillings.	
800	do.	8	"	
1,000	do.	6	"	
2,000	do.	4	"	
2,000	do.	3	"	6 pence.
2,000	do.	3	"	
1,800	do.	2	"	6 "
2,000	do.	2	"	
3,000	do.	1	"	6 "
4,000	do.	1	"	

Commissioners for canceling, the same as last.
Amount canceled,—see next issue.

[1] This emission was to replace torn and defaced bills.

1724.—July 24.

Amount, £6,630.

Form: This indented Bill, due from the Colony of New York, to the Possessor, shall pass in all Payments for....., pursuant to an Act of the Governor, Council and Assembly of the said Colony. Dated the Tenth Day of July, 1724.

Signed by David Provoost, Johannes Jansen, Jacobus Kip, John Cruger, Gerardus Beekman, or any three of them.

Description: Indented; the value of each bill printed at the top, bottom and each side, and impressed on the left side with the arms of the city of New York.

Number and division of the bills:

250	bills, each of	£3 12*s.*
380	do.	3 4*s.*
800	do.	1 12*s.*
1,495	do.	14*s.*
3,000	do.	7*s.*
4,000	do.	3*s.* 9*d.*
5,000	do.	1*s.* 3*d.*

Currency limited to July 1, 1729.

Commissioners for canceling, the same as last.

Amount canceled: Of the amount issued July 22, £3,000, and July 24, £6,630, amounting to £9,630, the sum of £9,469 16*s.* 6*d.* was canceled.

1726.—November 11.

Amount, £3,000.

Form: This Bill shall pass current in all Payments for ....., pursuant to a Law of the Colony of New York, November sixteenth, One Thousand Seven Hundred and Twenty-six.

Signed by Stephen De Lancey, Frederick Philipse, Anthony Rutgers, Robert Livingston, jr., or any three of them.

Description: Same as those issued July 22, 1724.

Number and division of the bills:

800	bills, each of	12	shillings.	
800	do.	8	"	
1,000	do.	6	"	
2,000	do.	4	"	
2,000	do.	3	"	6 pence.
2,000	do.	3	"	
1,800	do.	2	"	6 "
2,000	do.	2	"	
3,000	do.	1	"	6 "
1,600	do.	1	"	3 "
2,000	do.	1	"	

Currency issued to replace defaced bills.

Commissioners for canceling, the county justices of the peace.

Amount canceled, £2858 18*s.* 6*d.*

Printed by William Bradford.

1730.—October 17.

Amount, £3,000.

Form: By a Law of the Colony of New York, this Bill shall pass, within the same, for ....., in all Payments, and in the Treasury. Dated October xx, 1730.

Signed by John Cruger, Philip Van Courtlandt, Frederick Philipse, Henry Beekman, or any three of them.

Description: same as those issued July 22, 1724.

Number and division of the bills:

4,000	bills, each of	2	shilling 6 pence.
2,000	do	5	"
2,000	do	10	"
1,000	do	20	"

Currency, issued to replace defaced bills.
Commissioners for canceling, the signers.
Amount canceled, £2,999 10*s.*
Printed by William Bradford.

1734.— November 28.

Amount, £12,000.

Form: This Bill, by Law, shall pass current in the Colony of New York, for.....,in all Payments, and in the Treasury, New York, Fifteenth, November, One Thousand Seven Hundred and Thirty-four.

Signed by John Cruger, Frederick Philipse, Cornelius Van Horne, Stephen Bayard, or any three of them.

Description: Impressed on the left side with the arms of the city of New York.

Number and division of the bills:

300	bills, each of	£10.
600	do.	5.
800	do.	3.
800	do.	2 or 40*s.*
1,000	do.	1 or 20*s.*
1,000	do.	10*s.*
2,000	do.	5*s.*

Currency limited to March 25, 1746.
Commissioner for canceling, the treasurer.
Amount canceled, £11,576 15*s.*
Printed by William Bradford.

1737.— December 16.

Amount, £48,350.

Form: By a Law of the Colony of New York, this Bill shall pass current for.....December 10th, 1737.

Signed by James Alexander, Simon Johnson, Peter Schuyler, Peter Jay, or any three of them, and by the treasurer or loan officer.

Description: Impressed on the right hand side with the arms of the city of New York.

Number and division of the bills:

1,000 bills,	each of	£10.
2,000	do.	5.
3,000	do.	3.
4,000	do.	2.
5,000	do.	20 shillings.
7,700	do.	10 "
10,000	do.	5 "

Currency extended to 3d Tuesday in April, 1768.

Canceled in the presence of the justices and supervisors of the counties where loaned.

Amount canceled, £43,153 15*s.*

Printed by John Peter Zenger; engraved by Chs. Le Roux.

1739.—October 25.

Amount, £10,000.

Form: Same as last, except date.

Signed by John Moore, William Roome, David Clarkson, Peter Jay, or any two of them and the treasurer.

Description: Impressed on the right side with the arms of the city of New York. The amount of the respective bills at the lower part thereof.

Number and division of the bills:

200 bills,	each of	£10.
400	do.	5.
500	do.	3.
500	do.	2.
1,000	do.	1 or 20*s.*
3,000	do.	10*s.*
4,000	do.	5*s.*

Currency limited to Nov. 1, 1767.
Amount canceled, £9,115 6*s*.
Printed by William Bradford.

1746.— May 3.

Amount, £13,000.

Form: By a Law of the Colony of New York, this Bill shall pass current for.....New York, the Tenth of May, One Thousand Seven Hundred and Forty Six.

Signed by Cornelius Van Horne, Paul Richard, Henry Cruger, Robert Livingston, or any three of them.

Description: Impressed on the left side with the arms of the city of New York.

Number and division of the bills:

650	bills, each of	£10.
650	do.	5.
650	do.	3.
650	do.	2.

Currency limited to the first Tuesday of January, 1748.
Commissioners for canceling, the signers and treasurer.
Amount canceled, £12,618 12*s*.
Printed by James Parker.

1746.— July 15.

Amount, £40,000.

Form: Same as the last, except the date July 21.

Signed by Cornelius Van Horne, Paul Richard, Abraham Lynsen, Isaac DePeyster, or any three of them.

Description: Impressed on the right hand side, with the arms of the city of New York, and under the Arms "Its Death to counterfeit this Bill."

Number and division of the bills:

1,861	bills, each of	£10.
1,860	do.	5.
1,860	do.	3.

Number and division of the bills (continued):

1,861	bills, each of	£10.
1,860	do.	2.
1,860	do.	1.
1,860	do.	10 shillings.

Currency limited to the first Tuesday of January, 1756.

Commissioners for canceling, the signers and treasurer.

Amount canceled, £38,772 10*s*.

Printed by James Parker.

1747.—November 25.

Amount, £28,000.

Form: Same as the last, except date.

Signed by Cornelius Van Horne, Paul Richard, Abraham Lynsen, Isaac DePeyster, or any three of them.

Description: Impressed on the left hand side with the arms of the city of New York, and underneath "Its death to counterfeit this Bill."

Number and division of the bills:

1,200	bills, each of	£10.
1,250	do.	5.
1,250	do.	3.
1,250	do.	2.
3,500	do.	20 shillings.

Currency limited to Nov. 25, 1756.

Commissioners for canceling, David Jones, Cornelius Van Horne, Paul Richard, and Henry Cruger.

Amount canceled, £27,098.

Printed by James Parker.

1755.—February 19.

Amount, £45,000.

Form: Same as the last, except date.

Signed by Isaac DePeyster, Oliver DeLancey, Nicholas Gouverneur, John Livingston, or any three of them.

Description: Same as those of July 15, 1746.[1]

Number and division of the bills:

2,094	bills, each of	£10.
2,092	do.	5.
2,092	do.	3.
2,093	do.	2.
2,092	do.	1.
2,092	do.	10 shillings.

Currency limited to the first Tuesday of November, 1761.

Commissioners for canceling: In the year 1753, the speaker of the house of assembly and four members from New York, were appointed standing commissioners for canceling all bills of the province, as they became due.

Amount canceled, £36,325.

Printed by James Parker.

1755.— May 3.

Amount, £10,000.

Form: Same as the last, except date.

Signed by Gabriel Ludlow, Abraham Lynsen, David Clarkson, James DePeyster, or any three of them.

Description: Same as those of Nov. 25, 1747.

Number and division of the bills:

200	bills, each of	£10.
200	do.	5.
250	do.	4.
300	do.	3.
1,250	do.	2.
1,100	do.	20 shillings.
2,000	do.	10 "
2,000	do.	5 "

Currency limited to the first Tuesday of November, 1762.

[1] Owen Sullivan was executed in 1756 for counterfeiting paper money, probably of this date.

Amount canceled, £7,550 6*s*.
Printed by James Parker.

1755.—September 11.

Amount, £8,000.
Form: Same as the last, except date.
Signed by Frederick Philipse, Philip Livingston, Beverley Roberson, Leonard Lispenard, or any three of them.
Description: Same as those of July 15, 1746.
Number and division of the bills:

200	bills, each of	£10.
300	do.	5.

Number and division of the bills (continued):

300	bills, each of	£4.
300	do.	3.
300	do.	2.
1,000	do.	20 shillings
1,000	do.	10 "
1,200	do.	5 "

Currency limited to the first Tuesday of November, 1761.
Amount canceled, £6,489 2*s*.
Printed by James Parker.

1756.—April 1.

Amount, £10,000.
Form: Same as the last, except date.
Signed by Paul Richard, Henry Cruger, William Walton, John Watts, or any three of them.
Description: Same as the last.
Number and division of the bills:

1,000	bills, each of	£10.

Currency limited to the first Tuesday of November, 1761.
Amount canceled, £7,640.
Printed by James Parker.

1756.—April 1.

Amount, £52,000.

Form: Same as the last, except date.

Signed by Robert R. Livingston, John Cruger, John Van DerSpiegel, William P. Smith, or any three of them.

Description: Same as the last.

Number and division of the bills:

2,200	bills, each of	£10.
4,000	do.	5.
2,000	do.	3.
1,000	do.	2.
2,000	do.	1.

Currency limited to the first Tuesday of November, 1766.

Amount canceled, £41,990.

Printed by James Parker.

1758.—March 24.

Amount, £100,000.

Form: Same as the last, except date.

Signed by Peter Van Brugh Livingston, David Clarkson, David Van Horne, Henry Cuyler, Jr., or any three of them.

Description: Same as the last.

Number and division of the bills:

8,000	bills, each of	£10.
4,000	do.	5.

Currency limited to the first Tuesday of November, 1768.

Amount canceled, £66,155.

Printed by James Parker.

1759.—March 7.

Amount, £100,000.

Form: Same as the last, except date.

Signed by Nathaniel Marston, John Morin Scott, Lawrence Reade, Andrew Barclay, or any three of them.

Description: Same as the last.

Number and division of the bills:

5,000	bills, each of	£10.
6,000	do.	5.
10,000	do.	2.

Currency, same as the last.

Amount canceled, £71,876.

Printed by William Weyman.

1760.—March 22.

Amount, £60,000.

Form: Same as the last, except date.

Signed by John Bogert, Jr., Robert G. Livingston, Elias DesBrosses, John Van Horne, or any three of them.

Description: Same as the last.

Number and division of the bills:

2,500	bills, each of	£10.
30,00	do.	5.
10,000	do.	2.

Currency, same as the last.

Amount canceled, £41, 970.

Printed by William Weyman.

1770.—Jan. 5.

Amount, £120,000.

Act repealed by the king, February 14, 1770.

1771.—February 16.

Amount, £120,000.

Form: By a Law of the Colony of New. York, this Bill shall be received in all Payments in the Treasury for ....., New York, the ..... day of ..... one thousand, seven hundred and seventy-nine.

Signed by Henry Holland, Walter Franklin, Theophylact Bache, Samuel Verplanck, or any three of them.

Description: Impressed with the arms of the city of New York, on the right hand side.[1]

Number and division of the bills:

5,000	bills, each of	£10.
6,000	do.	5.
6,000	do.	3.
5,000	do.	2.
6,000	do.	1.
8,000	do.	10*s.*
8,000	do.	5*s.*

Amount canceled, not known.

Printed by Hugh Gaine.

1775.—September 2.

Amount, £45,000 or $112,500.

Form: This bill shall pass current in all payments in this Colony for.....Spanish milled dollars, or the value thereof in gold or silver, according to the resolution of the Provincial Congress of New York, the second day of September, 1775.

Signed by Robert Ray, John Sebring, Evert Bancker, John Reade, John Broome, Jeremiah Brewer, Eleazer Miller, Thomas Tucker, William Denning, Abraham Brinckerhoff, Garrit Abeel, Abraham Livingston, Anthony L. Bleecker, William Mercey, or any three[2] of them.

Description: Impressed with the arms of the city and such other devices as the committee shall direct.[3]

[1] These bills were largely counterfeited. An act was passed in 1773, directing the signers to cause new plates to be prepared and 44,000 impressions struck off on thin paper and pasted over on the reverse side of the bills first emitted.

[2] Afterwards reduced to two.

[3] Counterfeited in Westchester county.

Number and division of the bills:

5,000	$10 bills.
5,000	5 do.
5,000	3 do.
5,000	2 do.
10,000	1 do.
5,000	50 cent do.

Currency limited $\frac{1}{2}$ to March 1, 1776; $\frac{1}{2}$ to March 1, 1777.

The amount canceled of this and the two succeeding issues, was £133,477 17*s.* 8*d.*

Printed by J. Holt.

1776.—August 13.

Amount, £200,000 or $500,000.

Form: This bill shall pass current in all payments in this State for ..... Spanish milled dollars, or the value thereof in gold or silver, according to the resolution of the Convention of New York, on the 13th day of August, 1776. *Excepting* those of the denomination of $\frac{1}{4}$, $\frac{1}{8}$, or $\frac{1}{16}$ of a dollar, which were in the form following:

This bill shall pass current in all payments in this State for Two shillings (or one shilling or six pence), being equal to ($\frac{1}{4}$ or $\frac{1}{16}$) of a Spanish milled dollar or the value thereof in gold or silver, according to the resolution of the Convention of New York, on the 13th day of August, 1776.

Signers not named.

Description: Same as last, with the addition "tis death to counterfeit."

Number and division of the bills:

20,000	$10 bills.
20,000	5 do.
20,000	3 do.
20,000	2 do.

Number and division of the bills (continued):

105,866	½ dollar bills.
105,867	¼ do.
105,867	⅓ do.
105,868	$\frac{1}{16}$ do.
6,000	⅑ do. for an extra.

Emission of the last session.

Printed by S. Loudon.

1776.—March 5.

Amount, £55,000 or $137,500.

Form: Same as the last, except the date.

Excepting: Those of the denomination of ⅔, ½, ¼, ⅙, ⅛ of a dollar, which were in the form following:

This bill shall pass current in all payments in this Colony for five shillings and four pence (or two shillings and eight pence, or two shillings, or one shilling and four pence, or one shilling), being equal to one-third (or ¼ or ⅙ or ⅛) of a Spanish milled dollar, or the value thereof in gold or silver, according to the resolution of the Provincial Congress of New York, on the 5th day of March 1776.

Signers not named.

Device, as the committee should direct.

Number and division of the bills:

2,350	$10 bills.
2,350	5 do.
2,350	3 do.
2,350	2 do.
30,000	1 do.
30,000	⅔ do.
30,000	½ do.
30,000	⅓ do.
30,000	¼ do.
30,000	⅙ do.
24,000	⅛ do.

Currency limited $\frac{1}{3}$ to March 1, 1779; $\frac{1}{3}$ to March 1, 1780; $\frac{1}{3}$ to March 1, 1781.

Printed by S. Loudon.

1781.—March 27.

Amount, $411,250.

Form: The Possessor of this Bill shall be paid..... Spanish milled Dollars by the thirty-first day of December, One Thousand Seven Hundred and Eighty Six, with interest from the 15th day of June, 1780, in like Money, at the rate of five per cent per Annum, by the State of New York; and the first Payment of Interest to be on the 15th day of June, 1782, according to an Act of the Legislature of the said State, of the.....Day of.....1781.

Signed by

Amount canceled, $397,000.

1786.—April 18.

Amount, £200,000.

Form: By a Law of the State of New York, this Bill shall be received in all Payments into the Treasury for.....New York, the.....day of.....One Thousand Seven Hundred and Eighty-six.

Signed by Evert Bancker, Henry Remsen, Jonathan Lawrence, John DePeyster, William Heyer, or any two of them.

Description: Impressed with the arms of New York on the right hand side.

Number and division of the bills:

6,000	$10 bills.
4,000	5 do.
6,000	4 do.
10,000	3 do.
10,000	2 do.
24,000	1 do.
20,000	10 shilling bills.
48,000	5 do. do.

Currency limited to June, 1800.
Amount canceled, $185,165 10*s*.

1788.

As the bills of the issue of 1786 were largely counterfeited, the legislature in 1788 (Feb. 8) passed an act creating new bills to be substituted for such of them as were still in circulation. They were similar to the last excepting the date, and the addition of the words, "'tis death to counterfeit."

Signed by Daniel McCormick, Hendrick Wyckoff, John DePeyster, Nicholas Hoffman.

RECAPITULATION.

Date.	Amount Issued.			Amount Canceled.		
	£.	s.	d.			
1709	5,000	0	0	Not Known.		
1709	4,000	0	0	do.		
1709	4,000	0	0	do.		
1711	10,000	0	0	do.	£. s.	d.
1714	27,680	0	0	27,406	8	0
1715	1,200	0	0	1,190	5	0
1717	16,607	0	0	16,351	0	0
1720	2,000	0	0	1,896	8	6
1723	2,140	0	0	2,122	10	0
1724	3,000	0	0	9,469	16	6
1724	6,630	0	0			
1726	3,000	0	0	2,858	18	6
1730	3,000	0	0	2,999	10	9
1734	12,000	0	0	11,576	15	0
1737	48,350	0	0	43,153	15	0
1739	10,000	0	0	9,115	5	0
1746	13,000	0	0	12,618	10	0
1746	40,000	0	0	38,772	10	0
1747	28,000	0	0	27,098	0	0
1755	45,000	0	0	36,325	0	0
1755	10,000	0	0	7,550	6	0
1755	8,000	0	0	6,489	2	0
1756	10,000	0	0	7,640	0	0
1756	52,000	0	0	41,990	0	0
1758	100,000	0	0	66,155	0	0
1759	100,000	0	0	71,876	0	0
1760	60,000	0	0	41,970	0	0
1771	120,000	0	0			
1775	45,000	0	0	133,477	17	8
1776	55,000	0	0			
1776	200,000	0	0			
1781	$411,250*			$397,001†		
1786	£200,000	0	0	£185,165	10	0
Total,	£1,655,857	0	0			

* Or £164,500.
† Or £158,800.

List of Acts passed by the Legislature of New York relating to Paper Currency from 1709 *to* 1789.

1709.—June 8: An act for the currency of bills of credit for five thousand pounds.

Nov. 1: An act for the currency of bills of credit for four thousand pounds.

Nov. 12: An act for the currency of bills of credit for ten thousand ounces of plate, or fourteen thousand five hundred and forty-five Lyon dollars.

1710.—Nov. 25: An act to retrench the growing interest of bills of credit.

1711.—July 26: An act for the currency of twenty-five thousand ounces of plate.

1714.—Sept. 4: An act for paying and discharging the several debts and sums of money claimed as debts of this colony, to the several persons therein named, and to make and enforce the currency of bills of credit, to the value of twenty-seven thousand six hundred and eighty pounds, for that purpose; also to make void all claims and demands made, or pretended to be due from this colony, before the first day of June, one thousand seven hundred and fourteen, and to prevent this colony from being in debt for the future.

1715.—May 19: An act explaining the act of 1714.

July 5: An act for a supply to be granted to his majesty for supporting his government in the province of New York, and for striking bills of credit for that purpose.

1717.—Dec. 23: An act for paying and discharging several debts due from this colony, to the persons therein named: and for raising and putting into the hands of the treasurer of this colony, several quantities of plate, to be applied to the public and necessary uses of this colony, and to make bills of credit to the value of forty-one thousand five hundred and seventeen ounces and a half of plate, for that purpose.

1720.—Nov. 19: An act for continuing the currency of bills of credit to the value of six thousand ounces of plate for and during the time therein mentioned.

Nov. 19: An act for a supply to be granted to his majesty for supporting his government in the province of New York, during the time therein mentioned, and for repealing an act of the general assembly of this province, for a supply to be granted to his majesty for supporting his government in the province of New York, from the first day of July, which shall be in the year of our Lord, one thousand seven hundred and twenty, until the first day of July, one thousand seven hundred and twenty-one.

1721.—July 27: An act for the further continuing the currency of bills of credit to the value of six thousand ounces of plate, for and during the time therein mentioned.

1722.—June 22: An act for making more effectual, an act entitled, an act for a supply to be granted to his majesty for supporting the government in the province of New York, etc. (passed Nov. 19, 1721).

July 7: An act for continuing the currency of bills of credit to the value of three thousand ounces of plate, till the first day of July, which will be in the year of our Lord, one thousand seven hundred and

twenty, to the first day of July, which will be in the year of our Lord, one thousand seven hundred and twenty-four.

Nov. 1: An act for raising the quantity of three thousand ounces of plate, for the effectual sinking and canceling bills of credit to that value.

1723.—July 6: An act for raising and levying the quantity of five thousand three hundred and fifty ounces of plate, for the uses therein mentioned, and for striking and making bills of credit of that value.

1724.—July 24: An act for raising and levying the sum of six thousand six hundred and thirty pounds, for supplying the deficiencies of his majesty's revenue, and for the several uses and purposes therein mentioned, and for making of bills of credit to be issued for that value.

July 24: An act for making bills of credit, and putting the same into the treasurer's hands, for changing therewith such bills of credit of this province as are torn and defaced.

1725.—Nov. 10: An act for continuing bills of credit struck and issued in the year one thousand seven hundred and twenty, to the value of five thousand ounces of plate, to be current until the first day of July, which will be in the year one thousand seven hundred and twenty-seven.

1726.—June 17: An act for the further continuing the currency of bills of credit struck and issued in the year one thousand seven hundred and twenty, to the value of five thousand ounces of plate, until the first day of July, one thousand seven hundred and twenty-eight.

1727.—Nov. 11: An act for striking bills of credit to the value of three thousand pounds, and putting them into the treasury, to be exchanged for shattered, torn and defaced bills struck and issued by virtue of the several acts therein mentioned.

1728.—Aug. 31: An act to continue the currency of bills of credit struck and issued in the year one thousand seven hundred and twenty, to the value of five thousand ounces of plate until the first day of July, one thousand seven hundred and twenty-nine.

1729.—July 12: An act to continue the act last mentioned for one year.

1730.—Oct. 17: An act for striking bills of credit to the value of three thousand pounds, and putting them into the treasury, to be exchanged for shattered, torn and defaced bills struck and issued by virtue of several former acts.

Oct. 17: An act for the further continuing the currency of the bills of credit struck and issued in the year one thousand seven hundred and twenty, to the value of five thousand ounces of plate, during the time therein mentioned.

1732.—Oct. 14: An act to repeal the act, and to cancel the bills of credit therein mentioned, and to grant unto his majesty several duties for supporting his government in the colony of New York, until the first day of September, which will be in the year of our Lord, one thousand seven hundred and thirty-seven.

1734.—Nov. 28: An act to strike and make current bills of credit to the value of twelve thousand pounds, on the funds, and for the uses therein mentioned.

1735.—Nov. 8: An act to revive, enforce and continue the currency of bills of credit therein mentioned until the end of the year one thousand seven hundred and thirty-nine.

1737.—Dec. 16: An act for emitting bills of credit for the payment of the debts, and for the better support of the government of this colony, and for other purposes therein mentioned.

1739.—Oct. 25: An act further to continue the duty of excise, and the currency of the bills of credit emitted thereon; and to strike some new bills for exchanging such old ones as are or may be unfit to circulate.

1740.—Nov. 3: An act to cancel the bills of credit emitted in the year 1715, 1720, 1723, 1724.

1743.—Dec. 17: An act to prolong the currency of bills of credit emitted by virtue of an act entitled, an act for emitting bills of credit for the payment of the debts and for the better support of the government of this colony, and for other purposes therein mentioned.

Sept. 1: An act explaining the last mentioned act.

1746.—May 3: An act for raising a supply of the sum of thirteen thousand pounds, by a tax on estates real and personal, for the more effectual fortifying this colony; for the emitting bills of credit for the like sum for the immediate answering the necessary services, and for sinking and canceling the said bills at the several short periods therein mentioned.

July 15: An act for raising a supply of forty thousand pounds, by a tax on estates real and personal, for carying on an expedition against the French in Canada; for emitting bills of credit for

the like sum, and for sinking and canceling the said bills in short periods, and for other purposes therein mentioned.

1747.—Nov. 25: An act for raising a supply of twenty-eight thousand pounds, by a tax on estates real and personal, for defraying the expense of several services necessary for the defence of the frontiers and annoyance of the enemy; for emitting bills of credit for the like sum, and for sinking and canceling the said bills in short periods.

1748.—April 8: An act for the more effectual canceling the bills of credit of this colony.

1750.—Nov. 24: An act further to prolong the currency of bills of credit emitted by virtue of an act entitled, an act for emitting bills of credit for the payment of the debts, and for the better support of the government of this colony, and for other purposes therein mentioned.

1753.—July 4: An act to amend an act entitled, an act for the more effectual canceling the bills of credit of this colony.

July 4: An act further to continue the duty of excise, and the currency of bills of credit emitted thereon, for the purposes in the former act, and herein mentioned.

1755.—Feb. 19: An act for raising a supply of forty-five thousand pounds by a tax on estates real and personal, for putting this colony into proper posture of defence, for furthering his majesty's designs against his enemies in North America, and other, the purposes therein mentioned; for emitting bills of credit for the like sum, and for sinking and canceling the said bills in short periods.

May 3: An act for paying and subsisting eight complete companies of one hundred effective men each, officers included, to assist, in conjunction with the neighboring colonies, in erecting one or more forts nigh Crown Point, within his majesty's dominions; for raising the sum of ten thousand pounds, for and towards the said services, and for making current bills of credit to the amount thereof, and other the purposes therein mentioned.

Sept. 11: An act for raising the sum of eight thousand pounds, to be contributed to the colony of Connecticut, towards the expense of a reinforcement of two thousand effective men, now levying in the said colony, for the army destined against Crown Point under Major General Johnson; and for emitting bills of credit to the amount of the said sum of eight thousand pounds, for making immediate payment.

1756.—April 1: An act for the payment of the debts due from this colony, and for other purposes therein mentioned.

April 1: An act for raising, paying and subsisting, one thousand seven hundred and fifteen effective men, officers included, to be employed, in conjunction with the neighboring colonies, on an expedition for reducing the French fort at Crown Point, and carrying on an offensive war against the Indians who infest the western frontiers of this colony, and other purposes therein mentioned.

July 9: An act more effectually to suppress and prevent the counterfeiting of the paper currency of this colony.

Dec. 1: An act (continuing the act of Dec. 16, 1737).

1757.—Dec. 24: An act (continuing the act of Dec. 16, 1737).

1758.—March 24: An act for raising, paying and clothing, two thousand six hundred and eighty effective men, officers included, for forming an army of twenty thousand men, with the forces of the neighboring colonies, to invade the French possessions in Canada, in conjunction with a body of his majesty's regular troops, and other purposes therein mentioned.

Dec. 16: An act (continuing the act of Dec. 16, 1737).

1759.—March 7: An act for raising a supply of one hundred thousand pounds, for levying, paying and clothing, two thousand six hundred and eighty effective men, officers included, for forming, with the forces of the neighboring colonies, an army of twenty thousand men, to invade, in conjunction with a body of his majesty's regular troops, the French possessions in Canada; for emitting bills of credit for the like sum, and for sinking and canceling the said bills in short periods.

July 3: An act for emitting bills of credit to the amount of one hundred and fifty thousand pounds, to enable his majesty's general to pay the debts contracted, and to carry on his majesty's service in North America, and for sinking the same within twelve months.

Dec. 24: An act (continuing the act of Dec. 16, 1737).

1760.—March 22: An act for levying, paying and clothing, two thousand six hundred and eighty effective men, officers included, for forming an army of twenty thousand men, with the forces of the neighboring

colonies, to reduce, in conjunction with his majesty's regular troops, Montreal, and other posts belonging to the French in Canada; for emitting bills of credit for the sum of sixty thousand pounds, and for sinking the said bills in short periods.

Nov. 8: An act (continuing the act of Dec. 16, 1737).

1761.—Dec. 31: An act (continuing the act of Dec. 16, 1737).

1762.—Dec. 11: An act (continuing the act of Dec. 16, 1737).

1763.—Dec. 13: An act (continuing the act of Dec. 16, 1737).

1770.—Jan. 5: An act for emitting the sum of one hundred and twenty thousand pounds, in bills of credit to be put out on loan, and to appropriate the interest arising thereon, to the payment of the debts of this colony, and to such public exigencies as the circumstances of this colony may from time to time render necessary. (Repealed by the king, Feb. 14, 1770).

1771.—Feb. 16: An act (title, same as last).

1773.—March 8: An act to remedy the evil this colony is exposed to from the great quantities of counterfeit money introduced into it.

1774.—March 9: An act to prevent the depreciating the paper currency of this colony.

1775.—April 3: An act to amend (the act of Feb. 16, 1771) so far only as it relates to the county of Suffolk.

1779.—Feb. 26: An act to cancel certain bills of credit of this state (of the denomination of $1 and under issued by the provincial congress).

1780.—March 1: An act to cancel the defaced bills of credit at this state.

June 20: A supplementary act to the act entitled, an act approving of the act of congress of the 18th day of March 1780, relative to the finances of the United States, and making provision for redeeming the proportion of this state of the bills of credit to be emitted in pursuance of the said act of congress.

Oct. 7: An act to procure a sum in specie, for the purpose of redeeming one sixth part of the bills emitted on the credit of this state, pursuant to the act of congress of the 18th day of March, 1780, for discharging the interest of such bills, and for other purposes therein mentioned.

1781.—February 22: An act for the better establishing the rate of exchange between the bills emitted upon the credit of this state, pursuant to the act of Congress of the 18th of March, 1780, and the continental currency theretofore issued.

March 27: An act for emitting moneys upon the credit of this state.

July 1: An act to repeal such of the laws of the state which make several emissions of bills of credit a legal tender.

1785.—March 14: An act for canceling the bills of credit therein mentioned.

1786.—April 18: An act for emitting the sum of two hundred thousand pounds in bills of credit for the purposes therein mentioned.

May 1: An act supplementary (to the above).

1788.—February 8: An act to take out of circulation the bills of credit emitted by law, and to emit others as a substitute.

1789.—February 20: An act directing the treasurer of this state to cancel certain bills of credit and certificates therein mentioned, and for the further direction of the loan officers.

Rate of Depreciation of Continental Bills of Credit, as fixed by an Act of the Legislature of New York, passed March 30, 1781, for the payment of Debts and the Settlement of Accounts.

Date.	Sum required to pay $100.	Per cent of value.	Date.	Sum required to pay $100.	Per cent of value.
1777, Sept. 1,	100	100	1778, Dec. 15,	679	14
" 15,	104	96	1779, Jan. 1,	742	13
Oct. 1,	109	91	" 15,	796	12
" 15,	115	87	Feb. 1,	868	11
Nov. 1,	121	83	" 15,	932	10.7
" 15,	127	79	Mar. 1,	1000	10.0
Dec. 1,	133	75	" 15,	1048	9.5
" 15,	139	72	Apr. 1,	1104	9.0
1778, Jan. 1,	146	68	" 15,	1156	8.7
" 15,	152	65	May 1,	1219	8.2
Feb. 1,	160	63	" 15,	1272	7.8
" 15,	167	59	June 1,	1344	7.4
Mar. 1,	175	57	" 15,	1404	7.1
" 15,	186	53	July 1,	1436	6.9
Apr. 1,	203	49	" 15,	1548	6.5
" 15,	214	46	Aug. 1,	1631	6.1
May 1,	230	43	" 15,	1709	5.8
" 15,	245	40	Sept. 1,	1800	5.5
June 1,	265	37	" 15,	1908	5.2
" 15,	281	35	Oct. 1,	2032	4.9
July 1,	303	33	" 15,	2151	4.6
" 15,	332	30	Nov. 1,	2340	4.3
Aug. 1,	348	28	" 15,	2433	4.1
" 15,	370	27	Dec. 1,	2597	3.8
Sept. 1,	400	25	" 15,	2741	3.6
" 15,	429	23	1780, Jan. 1,	2932	3.4
Oct. 1,	464	21	" 15,	3115	3.2
" 15,	500	19	Feb. 1,	3333	3.0
Nov. 1,	545	18	" 15,	3533	2.8
" 15,	584	16	Mar. 1,	3732	2.6
Dec. 1,	634	15	" 15,	4000	2.5

ART. III. *Preliminary Notice of the Fauna of the Potsdam Sandstone; with remarks upon the previously known Species of Fossils and Descriptions of some New Ones, from the Sandstone of the Upper Mississippi Valley.*[1]

[Read before the Albany Institute.]

In the final nomenclature of the New York geologists, the name POTSDAM SANDSTONE was adopted for the lowest stratified rock of the series known to contain fossils. The fossils of this rock then known, however, were so few, and their character such as to afford very unsatisfactory means of comparison with the fauna of any distant formation. It was nevertheless considered by them to hold a lower position than any of the rocks *then* recognized as constituting the Silurian System of Great Britain. Up to the time of publishing the first volume of the Palæontology of New York in 1847, little had been added to the fossils before known from the New York localities. In fact, neither time nor means for its exploration had been at the disposal of the author of that work, and the necessity of making collections and publishing within a

[1] A notice of this paper was read before the Albany Institute, April 29, 1862: and by an arrangement between the Publishing Committee and the Regents of the University, it was published in the Sixteenth Report on the State Cabinet.

The receipt of Dr. SHUMARD's paper* in June 1862, has enabled the writer to add some further information regarding the species described by Dr. D.D. OWEN from the same formation.

* "NOTICE *of some* NEW *and imperfectly known* FOSSILS *from the* PRIMORDIAL ZONE (POTSDAM SANDSTONE *and* CALCIFEROUS SAND GROUP) *of Wisconsin and Missouri*," by B. F. SHUMARD. Transactions of the Academy of Science, St. Louis, May 1862.

limited time prevented such investigations as would have been desirable. Since that period little has been added to the species before known from New York localities, except a single species of CONOCEPHALITES discovered by Mr. BRADLEY at Keeseville.

At a later period (1847 – 50), Dr. D. D. OWEN, in his investigations in Wisconsin, Iowa and Minnesota, discovered, in the sandstone of the Upper Mississippi valley, a comparatively abundant fauna, which he at first regarded as marking a horizon far below the Potsdam sandstone of New York, having considered the Saint Peters sandstone as the equivalent of that rock. In pursuing some investigtions in connection with the United States Survey of the Lake Superior region in 1850, I had an opportunity of tracing the formations from Drummond's island and St. Mary's river to the head of Green bay, and thence made a section across the country to the Mississippi river. The position of the sandstone on the St. Mary's admitted of no doubt; and its relative position to the lower limestone had before that time been well determined, and the same was likewise ascertained by the several exploring parties along different lines between Lake Superior and Green bay.

Throughout Wisconsin there is no difficulty in recognizing the following sequence:

TRENTON LIMESTONE;
BLACK-RIVER OR BUFF LIMESTONE;
BIRDSEYE LIMESTONE;
ST. PETERS SANDSTONE;
LOWER MAGNESIAN LIMESTONE, OR CALCIFEROUS SANDSTONE;
POTSDAM SANDSTONE.

The St. Peters sandstone holds the place of the Chazy limestone of the more eastern localities; and, with this exception, we have the same sequence that we find in

New York, many of the fossils being common to the limestone of New York and Wisconsin.

Dr. OWEN, in his published report, has adopted this view of the sequence, and the explorations of subsequent years have confirmed the opinions then entertained; and I believe at this time every geologist will admit the identity of the Potsdam sandstone of New York and the lower sandstone of the Upper Mississippi valley.

In speaking of this sandstone, I shall, therefore, without hesitation, refer to it as the Potsdam sandstone.

As before remarked, the meagre fauna originally known in this rock in New York was not sufficient to parallelize it with any European formation, while it was shown to be strongly separated from the next succeeding groups; but since the discovery of these numerous fossils in the Mississippi valley, there has been no longer any hesitation in recognizing the Potsdam sandstone as equivalent in part, and in parallelism with the Primordial zone so fully established in Bohemia by the researches of M. BARRANDE.

These preliminary remarks appear to be necessary; since so far as we now know, there are no species of fossils in the western sandstone which are positively identical with those of New York; and those geologists who adopt the opinion that identity of species is required to prove equivalency of age in formations, may take exceptions to the views here advanced.

With the hope of adding to our knowledge of the primordial fauna of the northwest, I have, with much labor, selected from very extensive collections of trilobitic remains made at intervals from 1850 to 1859, all that appeared to me of sufficient importance to be illustrated. In a friable sandstone with no vestige of the crust remaining, these fossils offer very unsatisfactory material for investigation. It is, however, apparently impossible to obtain better specimens; for in all the localities examined,

the condition is essentially the same. Everywhere fragmentary, the fossils have often been drifted together in such numbers as to make it difficult to trace the limits of individual parts. In a single instance only have a few articulations of a thorax of a trilobite been seen in connection, and these so badly crushed as to be of no use for illustration. The material consists of glabellæ, separated cheeks, caudal shields, and fragments of thoracic articulations, either lying separately or crowded together, sometimes forming the principal part of layers one or two inches or more in thickness.

It must be confessed that working with such material is very unsatisfactory; and it has been only after most diligent search in many localities, that I have yielded to the necessity of determining and illustrating species from fragments such as are here given. These species, however, have not been determined from single fragments. In some instances twenty or fifty examples occur; and of most of them, five to ten have been studied. Some of the species have a considerable horizontal range; while others, as far as known, are restricted to a single locality.

I have not been able to make out, with certainty, the regular occurrence of successive trilobite beds, as given by Dr. OWEN; but my means of exploration have not been as extensive as were his. It is clear, however, that there is a succession among the species; and we shall probably be able to recognize the fact that those forms occurring near the base of the formation do not extend above the middle, while those of the central portions are not found throughout its entire thickness.

While recognizing some of the species of DIKELOCEPHALUS of OWEN as CONOCEPHALITES,[1] I find the former in

[1] This has already been done by Dr. B. F. SHUMARD in his paper cited, and I have, therefore, the less hesitancy in publishing this opinion. The personal and traditional knowledge of the originals of Dr. OWEN's species, possessed by Dr. SHUMARD, renders his remarks of peculiar interest and value.

well characterized species in the higher beds of the sandstone, and in the succeeding magnesian limestone. The lower beds are especially characterized by the presence of CONOCEPHALITES; but I hesitate to admit, among these, the occurrence of the Genus DIKELOCEPHALUS. Notwithstanding the late determination by Dr. SHUMARD of the *D. latifrons* from the lower beds, I cannot avoid the conclusion that this too, with its "truncated conical" glabella, is a CONOCEPHALITES.[1] In the intermediate beds, however, we have the *Dikelocephalus miniscaensis* of OWEN, which he cites from the third Trilobite bed of F 1, two hundred or two hundred and twenty feet below the top of that formation. In all the specimens obtained, I have failed to find one of this species with a facial suture corresponding to typical DIKELOCHEPHALUS, notwithstanding that some of the specimens appear to preserve entire the central portion of the cephalic shield. The direction of the suture is more nearly as in ARIONELLUS, and the places of the eyes more anterior than in *Dikelocephalus minnesotensis* or *D. pepinensis*; while the cheek is short and broad, and much extended at the posterior angle. It appears to me, therefore, that this species should be admitted into the latter genus only after satisfactory evidence of its character shall have been obtained. The typical species, *D. minnesotensis* of OWEN, is cited as occurring in member *d* of F 1, "ninety or one "hundred feet below the base of the Lower Magnesian "limestone, near the margin of Lake St. Croix above "Stillwater; towards the base of Lagrange mountain, "and at the great slide below Lake Pepin, which is the "fifth trilobite bed of the series of F 1." The *D. pepinensis* found in the same association as the preceding.

The interval between the lower beds at Mountain island, and those in which these two species of DIKELOCEPHALUS

[1] See remarks under the generic description of CONOCEPHALITES. See *post.*

occur is between four and five hundred feet. This interval may be represented by a greater or less thickness in other parts of the group. It may have been accumulated in a comparatively short time, or it may represent a long period; for although some parts of the series appear to have been rapidly accumulated, there are lines of demarkation indicating a change in the nature of the sediment, and other evidences of beach and shore lines with fucodal remains, together with mud-cracks and other marks of desiccation, so that we cannot be sure that the accumulation was equal and constant. It may, therefore, represent an interval, which, in some other part of the country, will be found occupied by a much greater thickness; and these successive trilobite beds may be representatives of that which, in other localities, will be found characterized by a more considerable and distinct fauna. I make this suggestion, from the facts which have fallen under my observation during investigations much too limited in time and area to afford such satisfactory results as I could desire.

It is an interesting and significant fact that the two most characteristic forms of DIKELOCEPHALUS commenced their existence near the close of the Potsdam period proper, passing into the alternating lower beds of the Magnesian limestone; while but one other species of Trilobite has been found in the same association, so far as my investigations have extended.

It is, perhaps, premature to generalize from these few facts; but according to our present knowledge of the Upper Mississippi valley, we are compelled to regard the typical forms of DIKELOCEPHALUS as characteristic of the close of the Potsdam period.

In addition to the Trilobites, we have a single species of AGNOSTUS, and a new and remarkable Crustacean; the latter from the higher beds of the sandstone, or within about fifty feet of the Lower Magnesian limestone.

The fauna of this sandstone, other than that of the crustaceans, is comparatively meagre, consisting of a few species of LINGULA, a DISCINA, an OBOLELLA?, an ORTHIS, two Gasteropods, one THECA and a SERPULITES?

Of the lower orders of animal life, we have very little at our disposal for its illustration. We know, however, that the family of GRAPTOLITIDÆ appeared in beds which are somewhat above the centre of the formation. Crinoidal columns are cited by Dr. OWEN as occuring in several localities, and I have seen a single obscure specimen which is apparently referable to this family of fossils.

The absence of animal life, in greater variety of forms, seems to be due to the unfavorable character of the sediment, rather than to any other cause. From the fact that every bed, however thin, where there is an admixture of sand with argillaceous matter, or with a small portion of calcareous matter, is seized upon, as it were, for the habitations of these animals, it is evident that it needed only a more favorable condition of the ocean bed to have developed an extensive fauna. We are, I think, moreover warrented in concluding that at some not far distant but now unknown point, this condition did exist in a much higher degree than in the localities investigated.

In order to make this notice as complete as possible with the materials I now possess, I have, with few exceptions, given illustrations of the species known to me as occuring in this sandstone in the Upper Mississippi valley.

GRAPTOLITIDÆ.

GENUS DENDROGRAPTUS (HALL).

DENDROGRAPTUS HALLIANUS (PROUT).

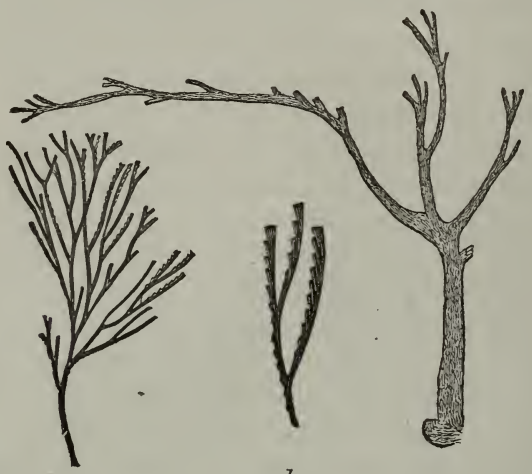
Graptolithus hallianus: PROUT, Am. Jour. Science (2), xi, p. 187, 1851.

FROND proceeding from a distinct root. Stems strong, numerously branched: branches divaricating, and fre-

quently subdivided; divisions serrate or celluliferous; cellules numerous, little elevated above the axis, and not mucronate.

The following figures, already given in the Geological Report on Wisconsin, illustrate the species, so far as the specimens in my possession serve to furnish character.

DENDROGRAPTUS HALLIANUS (Prout.)



a *b* *c*

a. A portion of the frond of the natural size.

b. An enlargement of one of the branchlets, showing the cellules.

c. The main stipe and some of the principal branches, natural size. There is a swelling or protuberance at the base, or radicle, one side of which is broken off.

This species occurs in beds somewhat above the middle of the formation, at Osceola mills on the St. Croix river.

BRACHIOPODA.

GENUS LINGULA[1] (BRUGUIERE).

[1]The Genus LINGULA has been recognized in the lower rocks, from its similarity of external form and texture to the recent LINGULA. It may be doubtful whether the internal structure and arrangement of muscular impressions has been determined in any one of these, and it will probably be a long time before this will be done for any large number of the species.

LINGULA AMPLA.

PLATE I. FIG. 10.

Lingula ampla : OWEN, Geol. Report on Wisconsin, Iowa and Minnesota, p. 583, Tab., 1 B, f., 5.

Dr. OWEN describes this species as having the following characters :

"A greater circumference and superficial area than any of "the others hitherto discovered, in F 1. Shell nearly "oval, rather flat: beak blunt and not projecting beyond "the general contour of the shell, and formed more "after the beaks of TEREBRATULA. A few faint concen- "tric striæ. Length $\frac{11}{16}$ of an inch, width $\frac{8}{16}$ of an inch."

The species is cited from "the Obolus grits, member *c*, near Mountain island;" and "at the Dalles of the St. "Croix, and elsewhere in Wisconsin."

In the lower beds at Trempaleau there occurs a large LINGULA, which, in its greatest dimensions, is about $\frac{9}{16}$ by $\frac{11}{61}$ of an inch: a specimen of this species is represented on Plate 2, fig. 22. Since this is the only one known to me in these lower beds, from which *L. ampla* has been cited by Dr. OWEN, I am forced to regard it as the typical form of the species.

The shell is rather flat, compared with its size, but not so flat as a species in the higher beds. In well preserved specimens, the lamellose concentric striæ are well defined, but I have not observed any radiating striæ: the cardinal slopes are nearly straight for more than one-third the length ; the beak is robust and obtuse [the figure represents the beak too acute].

This species is quite distinct from any of those in my collection from St. Croix river, and I can scarcely suppose it occurs in that position. Its citation thence by Dr. OWEN has probably arisen from some admixture of specimens. The specimens from "elsewhere in Wisconsin" may have been a species of similar form and size from the higher beds of the formation.

Recent examinations lead me to doubt, much against my inclination to disturb the generally received opinion, whether any of these older forms belong to LINGULA proper.

This LINGULA characterizes the lowest fossiliferous beds of the formation on the Upper Mississippi river near Trempaleau, and opposite the mouth of Black river.

LINGULA WINONA (n. s.).

PLATE I. FIG. 9.

Shell small, subquadrilateral, the front nearly straight; sides nearly straight and parallel: apex obtuse, the cardinal margins sloping at an angle of eighty degrees. Surface marked by fine concentric striæ.

This species occurs among some obscure and imperfect specimens from Lansing in Iowa, and is readily distinguished by its short broad form, being less than a fourth of an inch in length and breadth. It is quite distinct from any of those in the lower or upper beds of the series; occuring more than two hundred feet below the Lower Magnesian limestone, and near the middle of the Potsdam sandstone.

LINGULA MOSIA (n. s.).

PLATE I. FIGS. 1 – 3.

Shell small, subelliptical or ovate-spatulate, little convex, concentrically striated. The slopes below the beak are sometimes nearly straight for a short distance, and often curving from the beak to the base. The specimens are for the most part impressions in sandstone, with little of the shell remaining, but the form is very distinct from any of the described species; and being limited in vertical range, and with a somewhat wide horizontal extension, it becomes of interest in its associations.

I have given three varieties of form, which for the present I refer to a single species.

Fig. 1. An elliptical form which presents some characters indicating a distinct species, but which for the present I leave with the others.

Fig. 2. A specimen of the ordinary size, with nearly straight sides and front, and the cardinal slopes straight.

Fig. 3. An ovate form from the same horizon.

Fig. 4. A more broadly ovate form from the Calciferous sandstone at Stillwater, Minnesota.

This species is intermediate, in form, between *L. antiqua* and *L. prima* of the Potsdam sandstone in New-York, but is distinctly different from either of them. It occurs in the same association with *Dikelocephalus minnesotensis* at Lagrange mountain in Minnesota, and in the same horizon and similar association near Mazomania, Wisconsin.

LINGULA AURORA.

PLATE I. FIGS. 4 & 5.

Lingula aurora: HALL, Annual Geological Report of Wisconsin, 1860–61.

SHELL broadly ovate: beak obtuse, appressed, a little more attenuate in the ventral valve; sides abruptly diverging from the beak, including between them an angle of about 85°. Cardinal slope sometimes nearly straight for less than a third of the length, beyond which it is regularly curved: base broadly rounded, nearly flat or but little elevated.

SURFACE marked by concentric striæ; and on the middle and front of the exfoliated specimens, radiating striæ are more or less distinctly visible. Besides these, there is a transverse, sharply undulating, or zigzag set of lamellose striæ crossing the others, giving a finely checkered or subpunctate character. In partially exfoliated shells, or in the impressions in sandstone where the shell is mainly dissolved, the surface has a punctate aspect, and, except by a lens, is not distinguishable from such texture.

The surface characters are similar to those of *L. punctata* of the Hamilton group.[1] It resembles the *L. ampla* of OWEN; only in general form and size.

At the time of describing *L. aurora*, I had not fully considered the restrictions of character and position of the *L. ampla* of OWEN; but on a review of all the facts, I am satisfied that the latter name must apply to the Trempaleau species, while the name *L. aurora* will be applied to the one from the higher beds.

[1] Vol. iv, Palæontology of New York, and page 21 of the Report.

It occurs in association with *Dikelocephalus minnesotensis*, near Mazomania, Wisconsin, in the upper part of the Potsdam sandstone.

LINGULA AURORA, *var.*

PLATE I. FIGS. 6–8.

SHELL ovate, depressed convex, one valve apparently a little longer than the other: apex obtuse.

SURFACE, in the casts and partial casts, marked by concentric and radiating striæ, giving sometimes a cancellated or granulose structure. The transverse lamellose striæ are coarser, and not so abruptly undulating as in the specimen from the gray sandstone below.

This form occurs in considerable numbers in some red and variegated calcareo-magnesian layers near the top of the Sandstone series, and near the base of the Lower Magnesian limestone.

This and the preceding species are the only LINGULÆ which I have observed in the higher beds of the formation, with the exception of a few obscure specimens, the characters of which cannot be fully determined.

Although I have heretofore been disposed to consider that at least one of the species of LINGULA of the Potsdam of New York occurs in the North-west (and the same has been recognized by Dr. OWEN), nevertheless, after a careful examination of the collections in my possession, I am unable to satisfy myself that either *L. prima* or *L. antiqua* has been found in the Mississippi valley. The species of LINGULA present so few salient characters, that it is not surprising that cursory examinations of these fossils, as they are crowded together in great numbers in the beds at St. Croix falls, or when scattered in the sandstone, poorly preserved and often distorted, should sometimes lead to erroneous determinations, which can only be corrected by longer continued examinations and comparisons.

Dr. OWEN has described, under the name *Lingula pinnaformis*, the spatuliform LINGULA from the St. Croix falls, as follows:

"*Specific character.* Shell shaped much like a PINNA, "moderately convex, expanded and running to a point "at the beak, which, in the dorsal valve, is long, conical "and slender, curved towards the beak of the ventral "valve, which it overhangs and embraces as with a "deltidium. Surface marked with fine concentric striæ: "when exfoliated, longitudinal striæ can also be detected "towards the circumference of the shell. Length $\frac{5}{8}$ of "an inch; greatest width, $\frac{7}{16}$ of an inch.

"This fossil is abundant in the silico-calcareous layers near the "base of member *b* of F 1 at the Falls of the St. Croix, Minnesota."

The description above applies to the spatulate forms with elongate slender apices, which are common at the Falls of St. Croix. Associated with these, and in about equal numbers, there is a broad and much shorter form with rounded beak, the margin of which is a little concave from the inner side (as seen from the extremity), apparently for the passage of a peduncle. Among hundreds (and even thousands) of individuals examined, I have never seen two valves of this or the other form in their natural relations. Of both forms, the valves are always separated.

The description of Dr. OWEN does not define the two valves; and since he has recognized ORBICULA and other species of LINGULA in the same beds, I have been in doubt regarding his views of these two forms and their relations to each other.

In order if possible to decide their relations, I have had the shell removed from several individuals, that the casts might be studied. By this process, I have decided that the muscular impressions in the two are considerably different; but they may pertain to the dorsal and ventral valves of a species, while at the same time their characters do not furnish positive evidence that they are not of distinct species.

The muscular impressions are so unlike LINGULA as to afford little means of comparison; that of the shorter valve

resembling the flabelliform muscular impressions of the ventral valves of ORTHIS, like *O. oblata* and *O. vanuxemi.* The muscular impression in the spatulate valve is narrow above, gradually widening in the middle, with a central line: while its lower part is divided into three lobes, the central one shorter, the lateral ones longer, and diverging so that the outer margins of the impression are nearly parallel to the margin of the shell. The central longitudinal line seems to have been made by an extremely thin septum, which does not reach to the lower extremity of the central muscular impression.

Although several specimens of the broader and shorter form have been exfoliated so as to show the muscular impression, they are all of the same character, and I am compelled to infer that they are of the same valve. At the same time, three individuals of the spatulate form (which have been exfoliated with much difficulty) all presented an identical form of muscular impression.

Notwithstanding that these fossils have all the external characteristics of LINGULA, from which it would be very undesirable to separate them, were it possible to do otherwise, yet the form of muscular impressions is so unlike that of modern LINGULÆ, as well as those in the Devonian rocks which I have seen, that it becomes necessary to propose some other designation. In order to retain some indication of their relations, I propose the name LINGU-

GENUS LINGULEPIS (n. g.).

SHELLS linguloid, inequivalve, equilateral, oval-ovate or spatulate: muscular impression, in one valve, flabelliform; in the other, tripartite, the lateral divisions larger. Shell corneous, phosphatic.

The characters above described are from specimens of apparently

opposite valves from the St. Croix falls: their relations are not positively known, no entire specimens having been obtained.

LINGULEPIS PINNAFORMIS.

(LINGULA PINNAFORMIS (OWEN).)

PLATE I. FIGS. 14 & 16; AND? FIGS. 12, 13 & 15.

Lingula pinnaformis: OWEN, Geological Report of Wisconsin, Iowa and Minnesota, pa. 583, Pl. 1 B, f. 468.

" " : IDEM, Rep. of Wis., Vol. i, p. 21, f. 3, and p. 435.

SHELL spatulate, upper part attenuate, acute, slightly truncate at the apex; convex in the middle, with the sides, towards the apex, abruptly incurved. Surface marked by lamellose concentric striæ; and, when exfoliated, coarse radiating striæ mark the surface of the cast below the middle. In some specimens, radiating striæ are faintly visible in the shell.

The ovate valve associated with the spatulate form has a smooth glossy surface, with fine concentric striæ; and, when exfoliated, the surface of the cast is very distinctly striated by fine even or somewhat bifurcating striæ. Should this form prove to be distinct from the spatulate one, I propose for it the name *Lingulepis matinalis.*

The species is common at the Falls of the St. Croix; and coarse sandy layers, containing the same fossils, occur near the mouth of the Miniska river in Minnesota.

GENUS DISCINA (LAMARCK).

DR. OWEN frequently cites ORBICULA among the fossils of the sandstone, and describes *Orbicula prima;* but the figures given are not satisfactory. These fossils are cited from the St. Croix falls, and upon specimens containing *Lingula pinnaformis.* So many individuals are indicated (figures 13, 16, 17, 18 & 19), that it is clearly a common fossil. Among a large collection made at the locality in

1850, I have been unable to find a DISCINA; and I have been disposed to believe that the broad convex linguloid form, so common in these beds, was at that time referred to ORBICULA.

In all the collections I have but a single specimen which I refer, with doubt, to DISCINA; but this is so obscure as scarcely to merit description. It is from the later beds of the formation, and in the same association with *Dikelocephalus minnesotensis*, at Mazamonia, Wisconsin.

DISCINA INUTILIS (n. s.).

PLATE I. FIG. 11.

SHELL small, elliptically subquadrate, concentrically striated: apex excentric, nearly marginal.

The specimen appears to consist of both valves, which in the pressure have slipped a little out of place. My only reason for indicating this obscure specimen, is, that ORBICULA (DISCINA) has been regarded as a common fossil of the Sandstone.

GENUS OBOLELLA (BILLINGS, 1861).

"*Generic characters.* Shell ovate, circular or subquadrate, "convex or plano-convex. Ventral valve with a false "area which is sometimes minute, and usually grooved "for the passage of the peduncle. Dorsal valve either "with or without an area. Muscular impressions in the "ventral valve four; one pair in front of the beak near "the middle or in the upper half of the shell, and the "others situated one on each side near the cardinal edge. "Shell calcareous. Surface concentrically striated, "sometimes with thin extended lamellose ridges.

"In general form, these shells somewhat resemble "OBOLUS, but the arrangement of the muscular im-

"pressions is different. In OBOLUS, the two central scars "have their smallest extremities directed downwards "and converging towards each other; but in this genus, "the arrangement is exactly the reverse."[1]

Mr. BILLINGS has given, of one of the species of the genus, the accompanying illustration of "*the interior of one of the valves*,

[1] In my Annual Report on the Progress of the Geological Survey of Wisconsin for 1860, I described as *Lingula? polita* * a fossil possessing characters intermediate to LINGULA and OBOLUS. I remarked that the shell had been referred to OBOLUS by Dr. OWEN, but that I was then unable to find satisfactory evidence of the characters of OBOLUS: neither were the characters those of true LINGULA. This Report was in the hands of the authorities, and the first form printed during my stay in Madison between the 25th of February and the 5th of March 1861; but the printing of the work was not resumed till the November following.†

Some time before the middle of December 1861, I received the pamphlet of Mr. BILLINGS, published the 21st of November, containing the description of the Genus OBOLELLA. In this pamphlet he cites as one of the genus "a small species from the Potsdam sandstone of the St. Croix "river in the Western States, where it occurs associated with primordial "Trilobites described by the late eminent geologist DALE OWEN."

Subsequently my attention was very rudely called to this paper by an article in the Canadian Naturalist by Mr. BILLINGS, charging me with having availed myself of the knowledge given in his pamphlet relative to OBOLELLA, to make the comparisons cited above. The same article, or a similar one, was republished in the American Journal of Science, which has shown a remarkable avidity in publishing anything that might cast reproach upon my labors, or injure me personally.

The fact that the shell which I had under consideration had been referred by Dr. OWEN to OBOLUS, *Obolus apollinus*, and OBOLUS (APOLLINUS?) "‡, was certainly sufficient to suggest some discussions on its relations to that genus, without a hint from any one.

Nevertheless, the species cited by Mr. BILLINGS, if the locality be correct, is clearly not the one described by me; for it does not occur at the Falls of St. Croix, nor on the St. Croix river "in the Western States," so far as I know; nor am I able to find, in Dr. OWEN's Report, any reference

* In printing of this Report, beyond the first form, no proofs were submitted to me, and the quere after LINGULA (?) was omitted by the printer.

† For evidence regarding the date of printing this Report, see Journal of the Wisconsin Senate, "Fifteenth Annual Session," page 181.

‡ See Geological Report on Wisconsin, Iowa and Minnesota, pp. 50, 53, 501, etc., and Table of species, etc., 631; also Explanation of Tab. 1 B.

"*supposed to be the ventral, showing the muscular impressions.*" This will afford the means of comparison with *O.? polita*, figures 20 & 21 on Plate 1.

OBOLELLA CHROMATICA (Billings).

The species of OBOLELLA, cited by Mr. BILLINGS from "the St. "Croix river in the Western States," and which he has identified with *Lingula? polita*, has, according to that author, "the central scars" "close together, one on each side of the median line and "parallel."

of such a form to the Falls of St. Croix: And furthermore I cannot find it anywhere stated by Dr. OWEN that the LINGULA and ORBICULA (or any OBOLUS or Obolus-like forms) "from the Potsdam sandstone of the St. "Croix river in the Western States," or the St. Croix river of Wisconsin and Minnesota, ever occur associated with primordial Trilobites in that locality. Dr. OWEN distinctly describes the "First Trilobite bed" as composed of "Ferruginous Trilobite grits, Schistose sandstone containing "forktailed Trilobite beds and Obolus layers, 1–8 feet; Magnesio-calca- "reous rock, with OBOLUS and forktailed Trilobite, 3 feet." The typical locality of these beds is at Mountain island, and they are placed by Dr. OWEN above the "highly fossiliferous, schistose, silico-calcareous layers, interla- "minated with argillaceous marly beds charged with sulphate [sulphu- "ret] of iron; the former full of Lingulas and Orbiculas (Falls of St. "Croix)."

At page 94, speaking of the strata above low water of the Mississippi near the mouth of Black river, and Mountain island, Dr. OWEN says: "Here, in addition to some species of the Genera LINGULA and ORBICULA "which occur at the Falls of St. Croix, there are some remarkable forms of "Trilobites, associated with numerous specimens of OBOLUS." It may be questionable, therefore, whether Mr. BILLINGS refers to the OBOLUS of Mountain island and Black river, or to the ORBICULA of St. Croix river, which is not associated with primordial Trilobites. If he refers to the former, then he should have done justice to Dr. OWEN by citing his observations.

Since, however, the author of the Genus OBOLELLA has taken such pains to proclaim to the world that the little *Lingula? polita* is an OBOLELLA, though mistaking its locality and position, it would be ungenerous to attempt to separate it from that genus.

It becomes necessary, in this connection, to notice the Genus SPONDYLOBOLUS of M'COY, published in the Annals Nat. History, 2d series, Vol. viii. p. 408; and in British Palæozoic Fossils, p. 255. 1855.

The following is the description of that genus:

GENUS SPONDYLOBOLUS (M'COY).

"GENERIC CHARACTER. Suborbicular, slightly narrowed "towards the indistinct short hinge-line, nearly equivalve, "flattened. Small valve with a slightly excentric apex; "beneath which, on the interior, the substance of the "valve is thickened into a wide undefined boss. Oppo- "site valve slightly longer, from the apex being perfectly "marginal and slightly produced, channeled by a narrow "triangular groove below, the anterior end of which is "flanked by two very prominent, thick, conical, shelly "bosses representing hinge-teeth: substance of the valve "thick, testaceous, not glossy, minutely fibrous, but not "distinctly punctated under a lens of moderate power, "except by the ends of these fibres."

Whether the characters here given are such as will bear some extension by the study of a larger number of species; and whether, if somewhat extended, they may not include some of those forms like OBOLELLA, I shall not discuss at the present time. With the exception that the apex of the small valve is described as slightly excentric, the description corresponds more nearly than that of OBOLELLA with the shell before me.

OBOLELLA ? POLITA.

PLATE I. FIGS. 17 - 21

Obolus apollinus: Owen (not Eichwald), Loc. cit.
Lingula? polita: Annual Geological Report, Wisconsin, 1860, p. 24.
" " : Owen Geol. Rep. Wisconsin, Vol. i, p. 21 and p. 435.

Shell small, short ovate, length and breadth nearly or quite equal; the greatest width near the front, which is broadly rounded. Valves moderately convex, with prominent umbones, somewhat inequivalve; beaks obtuse, one usually a little truncate or emarginate. Surface smooth, sometimes glabrous, with concentric striæ: shell calcareous ?, thick, fibrous or lamellose.

The interior of the ventral(?) valve has a broad somewhat cordiform subcentral duplicate muscular impression, with a raised margin. From the centre beneath the beak extends a low flatly rounded ridge, which reaches into and partially divides the muscular impression. On each side of this low ridge is a nearly flat slightly elevated plate or thickening of the shell, which, extending forward, is continued in its outer limbs in a raised border nearly around the muscular impression; giving to the whole a broad spatulate form, leaving a space in front where the shell is marked by a few radiating or vascular impressions. On each side of this central elevated plate, and at the anterior extremities of the cardinal line, are two smaller muscular impressions. There is a narrow groove beneath the apex of the valve, and on each side of this an elongate thickened boss or pad.

The dorsal (?) valve has a narrow central muscular impression, the limits of which extend in an acute point below the middle of the shell: on each side is a broader limited area, reaching two-thirds the length of the shell, and extending into the cavity beneath the beak. The whole presents an elongate somewhat cordiform area. No

marginal muscular impressions have been observed in this valve. Apex emarginate, with a prominent pad or tooth-like process on either side.

The following illustrations on Plate i, will serve to give a more complete idea of the form and characters of this fossil :

FIG. 17. Natural size.
FIG. 18. A figure enlarged about two diameters.
FIG. 19. Cast of a ventral valve.
FIG. 20. Interior of the ventral valve.
FIG. 21. Interior of the dorsal valve.

These last two figures illustrate all that has been observed in the interiors of these shells.

It is quite probable that specimens, preserved under more favorable circumstances, would show more clearly the character of the interior. Although it may not correspond with the Author's description of the Genus OBOLELLA, it is as clear and distinct a representation of the specimens in my collection as, with much care, could be given.

This species occurs in what I regard as the lowest known fossiliferous beds of the formation at Trempaleau, Black river, and other places. It is associated with *Lingula ampla*, *Conocephalites iowensis*, *C. chippawaensis*, and *Theca primordialis*. Some of the layers preserve fucoidal remains, ripplemarks, and evidences of beach lines.

GENUS ORTHIS (DALMAN).

ORTHIS PEPINA (n. s.).

PLATE I. FIGS. 23 – 27.

This species occurs as casts of the interior, and impressions of the exterior surface; and from the latter I have obtained casts from which the drawings have been made.

SHELL semielliptical. Dorsal valve convex, about three-fourths as long as wide, sometimes proportionally narrower: hinge-line as long as the greatest width of the shell. Ventral valve a little more convex than the dorsal, longer than wide, sometimes one-fourth longer than

wide: area, high, with beak much advanced; cardinal margins sloping backwards in a straight line to the extremities.

SURFACE strongly striated: striæ fasciculate, with a few concentric lines of growth. The cast of the ventral valve shows a strongly striated area, a large and long foramen, with the central portion marked by a few strong simple vascular impressions.

The area appears to have been on the same plane with the margins of the shell, and, in the casts, does not always show the strong transverse striæ. The cast of the dorsal valve shows very little of important features: it is regularly convex, and a little flattened in the middle. The cardinal process has been very thin and small, with marks of strong socket-plates: from the outer extremities of these proceed an impressed line which curves towards the sides, and is directed forwards, enclosing a space which is probably the muscular area.

Compared with *Orthis coloradensis*, in specimens from Texas, received from DR. FRANCIS MOORE, this species is usually smaller, the length of ventral valve proportionally greater, with a higher area and finer striæ.

FIG. 23. Dorsal valve of *Orthis pepina*.

FIG. 24. Ventral valve of same species, the form more than usually elongated.

FIG. 25. Cast of dorsal valve of same. The line limiting the muscular impression is made too strong, and the elevation of the central portions too abrupt.

FIG. 26. Cast of ventral valve, showing height of area, cast of rostral cavity, and vascular impressions.

FIG. 27. A cast of the ventral valve, showing a narrower area, with the cavities made by the dental lamellæ.

The specimen of the cast of the dorsal valve figured is the largest that has been found.

The *Orthis pepina*, though occurring in several localities, has been obtained in characteristic specimens only in yellowish and sometimes light buff-colored sandstone on Lake Pepin, above Reed's landing. It occurs at Miniska on the Mississippi river, and at Osceola on the St. Croix river.

GASTEROPODA.

GENUS PLATYCERAS (Conrad).

PLATYCERAS PRIMORDIALIS (n. s.).

PLATE I. FIG. 28.

Shell rotund, rapidly expanding from the apex, and spreading to a broad aperature: volutions about one and a half.

The specimen figured is a cast in friable sandstone, preserving scarcely more than evidence of its generic relations. It is chiefly interesting as showing the early existence of this form of Gasteropod. One or two other specimens only have been observed: they occur in gray sandstone with greenish particles on the Kickapoo river, and at Trempaleau, in a position below the middle of the formation.

GENUS EUOMPHALUS (Sowerby).

EUOMPHALUS? VATICINUS (n. s.).

PLATE I. FIG. 29.

Several specimens of a euomphaloid shell have been found in the sandstone of the Mississippi valley. One of these preserves about four volutions of regularly increasing size, and gently convex above. Another specimen shows a deep umbilicus, with the volution a little flattened on the lower side, and subangular on the periphery and umbilical margin.

These imperfect specimens are characterized only for the interest attached to their geological position and association.

FIG. 29. The upper side of a somewhat distorted specimen, from the upper portion of the formation at Lagrange mountain.

CRUSTACEA.

GENUS DIKELOCEPHALUS (Owen).

"Cephalic shield semicircular and rather flat. Glabella "moderarely convex, equally wide throughout, rounded "in front, divided by two furrows into three distinct "lobes: these well marked furrows extend quite across "the glabella, and form a curve or slightly obtuse angle "in the median line directed backwards. The anterior "lobe is partially divided by a third obscure furrow, "which becomes obsolete in the median line.

"Facial sutures distinct, originating in the anterior "[posterior] border of the cephalic shield: they run at "first parallel with the same; then converging in a "sigmoid flexure around the eye-plate, diverge again "in curved lines, until, reaching the anterior border, "they circumscribe an area of greater or less extent in "front of the glabella.

"The cheek-plates produced at their anterior [posterior] "corners into spines of moderate length.

"Pygidium rather deeper and about the same width as the "cephalic shield, with from four to six segments; the "last and largest segment sometimes obscurely subdi-"vided by a faint furrow. Lateral and interlateral seg-"ments blended into a marginal flap or border of greater "or less extent: usually, if not always, provided with "caudal spines."

In the form and expression of the glabella, there is considerable resemblance to Paradoxides, except that it is not expanded in front. The direction of the facial suture, however, is conspicuously different. The extended frontal limb in the typical species does not appear to be a generic feature; for in the *D. pepinensis* of Owen it is narrow and convex. The thoracic articulations are marked by a simple groove running out at the lower margin of the

distal extremity, which is pointed backwards. The hypostomæ associated with *D. minnesotensis* are very similar to the hypostomæ of PARADOXIDES. In the *D. pepinensis* we have a facial suture as in *D. minnesotensis*, with a narrow convex frontal limb; while the pygidium is narrow, prominently convex in the axis, with a plain border of moderate width.

In the fragmentary condition of all the specimens, it becomes exceedingly difficult to decide, in some instances, the limits of this genus. The glabella in *D. pepinensis* preserves but indistinctly the furrows anterior to the principal one crossing it. When carefully examined, however, we find two faint indentations on each side of the glabella, which may have been more considerable in the crust than appear in the cast. In the *D. minnesotensis*, I have failed to observe more than a single indentation on each side, anterior to the furrow which crosses the glabella. The posterior furrow is oblique at its extremities, as in the glabellar furrow of CONOCEPHALITES and some others: the second furrows, according to the generic description, are "obscure." In species like *D. spiniger*, where the glabella is slightly narrowed anteriorly, and the posterior furrow is deeply impressed at the sides and less strong in the middle, while the second one is conspicuously marked at the sides and faintly across the glabella, with a faint anterior furrow, we have a close approach to the characters of species referred to CONOCEPHALITIES; nor is it easy to determine the limits of these genera, from the fragments in our possession.

DIKELOCEPHALUS MINNESOTENSIS.

PLATE IV. FIGS. 5–10; PLATE V; AND PLATE VI. FIGS. 1, 3 & 4.

Dikelocephalus minnesotensis: OWEN, Geol. Report Wisconsin, Iowa and Minnesota, page 574, Tab. 1, f. 1, 2, 10; and Tab. 1 A, f. 3 & 6.

BODY large, somewhat quadrilateral, convex in the middle, with the sides and extremities depressed or flattened.

HEAD broad, semielliptical, with the posterior angles of the cheeks prolonged.

GLABELLA moderately convex, longer than wide, or as long

in front of the occipital furrow as the width; sides parallel; front rounded. Occipital furrow comparatively narrow and well defined, with a wide, nearly flat or little convex occipital ring. The posterior glabellar furrow crosses the glabella as far from the occipital furrow in the middle as the width of the occipital ring, and curves forward so as to terminate a little behind the anterior limit of the palpebral lobe. Anterior to this furrow there is on each side a shallow groove, reaching about one-third across the glabella.

The facial suture cuts the anterior contour in a nearly vertical line from the outer limb of the palpebral lobe, and is thence directed inwardly in a slightly curved line to the anterior limit of the palpebral lobe; thence turning almost rectangularly outwards, it curves gently downwards into the posterior limb of the cheek, at a distance from the dorsal furrow of five-sixths the width of the glabella. Dorsal furrow strongly defined at the sides, and distinctly limiting the glabella in front.

Fixed cheeks comparatively narrow, spreading opposite the centre of the palpebral lobe; the posterior limb about the same width as the cheek anterior to the eye, and deeply grooved; the frontal limb broad and nearly flat, without elevated or thickened border, or with this feature scarcely perceptible. The extension of the frontal limb is equal to a little more or less than half the width of the glabella.

Movable cheeks large, somewhat triangular, with a deep sinus at the inner angle for the place of the eye, convex towards the eye, and flattened or concave between this convexity and the outer margin: exterior limb scarcely thickened, produced posteriorly into a thin flattened spiniform process.

Hypostoma broad; the body convex and subcircular or very broadly oval, with margins expanded and furrowed near their antero-lateral angles.

In small specimens, there is a minute node near each anterior angle.

Thorax wide, the axis narrow, moderately convex, strongly defined by the dorsal furrow, less than one-fourth the entire width of the body: lateral lobes nearly flat, the segments marked by a simple groove which begins on the upper margin of the rib at the dorsal furrow, and, becoming central at a point about half the length of the rib, continues in the same direction, bending downwards and extending into the slightly recurved extremity.

Pygidium broad, more than once and a half as wide as long: axis very prominent; the lateral lobes convex near the axis, and, sloping rather suddenly downwards, become depressed and flattened towards the margin. Axis marked by four annulations, exclusive of the lower terminal one and the anterior articulating joint: lateral lobes marked by four ribs which are deeply divided from their origin, with a slight elevation close to the posterior extremity of the axis and the anterior simple rib. The extremities of the ribs terminate in a broadly expanded limb, which is gently curved at the sides, and produced at the postero-lateral angles into a short process, leaving a wide gently curving posterior margin.

The surface of the movable cheeks, of the caudal expansion, and of the extremities of the thoracic segments, is strongly striate. The lower surface of the pygidium is more strongly marked than any other part.

This species occurs in the higher beds of the formation, and usually within fifty to one hundred feet below the Lower Magnesian limestone. We also find a similar or identical species in the Magnesian limestone.

In its extremes of size, this species has a wide range. The smallest head which I have observed has a length of one-fourth of an inch, including the frontal limb; while the largest one has a length of more than two and a half inches, with a width between the extremities of the posterior limbs of the fixed cheeks of more

than four inches. A pygidium associated with the latter has a length of two and a quarter inches, with a width of more than three and a half inches. A fragment of a thoracic segment measures, from the centre of the axis to the extremity, more than two and a half inches; which would give the width of the body five inches. A pygidium found in a loose mass of Lower Magnesian limestone near Madison, Wisconsin, by Mr. S. V. SHIPMAN, measures nearly two inches and three-fourths in length, and four inches and three-quarters in width.

PLATE IV.

FIG. 5. A large head from Mazomania: the frontal limb is given in form and proportions from another specimen, in which it is preserved entire.

FIG. 6. A pygidium from Lagrange mountain.

FIG. 7. The pygidium of a large individual from the Magnesian limestone. This one presents some slight differences in the form and proportions of the axis, when compared with fig. 4 of Plate vi.

FIG. 8. A part of the thoracic segment from the Lagrange mountain locality.

FIGS. 9 & 10. Hypostomæ found in the same locality, and referred to this species.

PLATE VI.

FIG. 1. A hypostoma associated with the specimens of fig. 5 of Plate iv and fig. 4 of Plate vi, and clearly belonging to this trilobite.

FIG. 3. A cheek from Lagrange mountain. Similar cheeks occur with the preceding specimens, and some of them are much larger than this one; measuring two inches in width in the widest part, and an inch and a half in the narrower portion, or double the width of the one figured.

FIG. 4. A pygidium from Mazomania.[1]

The hypostoma, Plate vi, f. 1, is doubtless of this species; having been found associated with fragments of several large individuals at Mazomania, where I have not seen any other large trilobite.

The specimens figs. 9 & 10 of Plate iv are from Lagrange mountain: they present some differences, and both differ somewhat from the larger one. All are imperfect; the specimen figure 9 being more nearly entire than the others. They belong either to the *D. minnesotensis* proper, or to the form given in fig. 11, Plate iv; since no other species, except the *D. pepinensis*, and the extremely rare form fig. 12, Plate iv, are found at that locality; and the hypostoma of *D. pepinensis* is given in fig. 4, Plate iv.

[1] This specimen is associated in the same beds with fig. 5, Plate iv; having been obtained from the locality at a subsequent period.

DIKELOCEPHALUS MINNESOTENSIS, *var.* LIMBATUS.

PLATE IV. FIG. 12.

A single fragment shows the anterior part of the glabella, and nearly the whole of the frontal limb. In this specimen the antero-lateral angle of the frontal limb is more rounded, and the anterior margin elevated in a distinct border which does not appear to be thickened. Within this border are a few wrinkled striæ, directed towards the glabella. In a single small individual from Lagrange mountain, I have seen a similar but less defined border.

Without other specimens, I am unwilling to indicate this as a distinct species. It occurs with *D. minnesotensis* and *D. pepinensis*, at Lagrange mountain.

DIKELOCEPHALUS MINNESOTENSIS, *var.*

PLATE IV, FIG. 11; AND PLATE V, FIG. 9.

General form of head and glabella as in *D. minnesotensis*. Glabella moderately convex, and slightly narrowing in front of the eyes. Occipital furrow straight: posterior glabellar furrows oblique; the anterior one slightly marked, and nearly straight. The frontal limb is rounded at the antero-lateral angles, and slightly extended in the middle.

The marked difference between this form and the *D. minnesotensis* is in the frontal limb, which is extended in the middle so as to interrupt the continuous curve of the contour. A single individual, having this feature of the frontal limb in a marked degree, was found at Lagrange mountain; while two other individuals have been found at Stillwater, in the Lower Magnesian limestone or Calciferous sandstone.

These differences, of apparently minor importance, might not be regarded as worthy of specific distinction; but we have, at the

same time, a difference of form among the hypostomæ. Whether these are all varieties of form of one species, may admit of some doubt with our present means of comparison. It may be imprudent to multiply specific designations for such remarkable forms as the *D. minnesotensis*, and those presenting so many features in common with that species.

PLATE iv, fig. 11, is a small specimen (one side of which has been restored in the figure) from Lagrange mountain, Minnesota.

PLATE v, fig. 9. The glabella and fixed cheeks of a large individual from Stillwater, Minnesota.

In the latter specimen, the oblique truncation of the frontal limb on each side is not so extreme as in the smaller individual; and from the symmetrical contour still remaining, it appears as if separated along a suture line.

DIKELOCEPHALUS PEPINENSIS.

PLATE IV, FIGS. 1–4; AND PLATE V, FIGS. 13–17.

Dikelocephalus pepinensis : OWEN, Geological Report of Wisconsin, Iowa and Minnesota. page 574, Tab.1, f.9 & 9 *a ;* and Tab.1 A, f. 7 ?

BODY comparatively narrow, subelliptical, wider anteriorly. General contour of the head semielliptical, with extremely elongated cheek-spines.

GLABELLA prominent, longer than wide, usually a little narrowed anteriorly. Occipital furrow straight and narrow: occipital ring broad, depressed convex, not rising higher than the glabella in front of it. Posterior glabellar furrow a little oblique at the extremities, and straight in the middle: anterior to this furrow are two slight indentations on each side of the glabella, near the anterior limit of the palpebral lobe, which do not reach to its summit. Dorsal furrow strongly defined, and joining a wider furrow which limits the front of the glabella.

FIXED cheeks narrow, expanded in the direction of the eye, and separated by a distinct groove from the palpebral lobe; posterior limb narrow, with the furrow extending about half its length, and running out on the

upper side: frontal limb convex, a little wider in the middle than at the sides, separated from the glabella by a wide slightly curving furrow.

Movable cheek subtriangular, with a wide deep ocular sinus at the inner angle, convex towards the eye, with a wide shallow depression just within a broad elevated limb; posterior margin short, the genal angle produced in a long nearly straight spine, which is more than twice as long as the body of the cheek.

Hypostoma subelliptical, with a slight angular extension on each side a little behind the centre; border elevated along the sides, and slightly truncate in front: an oblique depression on each side near the anterior end, directed from the margin forward and towards the middle.

Axis of the thorax convex and strongly defined: lateral lobes wider than the axis, except at the posterior part, where they are nearly equal.

Pygidium somewhat semielliptical, wider than long, rounded in front: axis strong and highly elevated, conical, tapering somewhat rapidly, marked by five annulations besides the elongated posterior one and the anterior articulating segment. Lateral lobes convex near the axis, and at the middle of their width sloping abruptly downwards, with a flattened continuous margin; marked by four distinct ribs which are deeply divided throughout their length, and become merged in the flattened limb: the anterior simple rib is prominent, subangular, and continued to the margin of the border. The contour of the margin is apparently continuous and uninterrupted by spiniform extensions.

This species is readily distinguished from the preceding, by the narrow frontal limb of the glabella; in the cheeks, by the long spine; and in the pygidium, by the more prominent axis and less expanded border, without the posterior spiniform extensions.

PLATE IV, FIG. 1, shows the form of the glabella and fixed cheeks.
FIG. 2. The pygidum.
FIG. 3. A movable cheek.
FIG. 4. The hypostoma.

In the collection from Lagrange mountain in Minnesota, this species greatly outnumbers its associate the *D. minnesotensis*. It is not known to attain so large a size, nor does it occur in other localities so frequently, as that species. In the Mazomania collections I have seen but a single individual, and I have no specimens from any other place. DR. OWEN has cited only the locality of Lagrange mountain for this species.

DIKELOCEPHALUS SPINIGER (n. s.).

PLATE V. FIGS. 1, 2 & 3?

GLABELLA somewhat semicylindrical, very convex; sides gently converging, truncate in front; length little greater than the width: posterior furrows very oblique and deeply impressed for nearly one-third the width of the glabella, and continued by a more shallow furrow across the summit; second furrows indented at the sides, and continued across the glabella in a scarcely perceptible impression. The anterior furrows are slight indentations in the sides of the glabella, leaving a very narrow anterior lobe. The occipital furrow is deeply impressed, straight in the middle, and bending a little forward towards the extremities: occipital ring convex above, a little curving forward at the sides and very prominent in the middle, supporting a spine. Dorsal furrows strongly impressed, and more deeply marked in front of the glabella. The frontal limb is a regularly convex elevated band.

FIXED cheeks narrow at the sides, expanding in the direction of the palpebral lobes, which are defined by a strong furrow. The posterior limb is unknown.

In the same fragment of rock with the glabella, there is a pygidium which I have presumed to belong to this species. The axis is broad and prominent, marked by about five rings besides the articulating one; the lateral lobes slope abruptly downwards, then curving they spread in a broad flattened border (which is everywhere incomplete in the specimen); each side is marked by four ribs, exclusive of the anterior one; the two forward ribs are divided through a part of their length, and the four appear as gentle undulations in the border.

This species possesses the essential characteristics of glabella given by Dr. OWEN for DIKELOCEPHALUS, except the slight convergence of the sides; and I have therefore referred it to that genus.

The glabella, frontal limb and fixed cheeks resemble *D. pepinensis;* but the occipital ring in this one is more convex, and bears a spine; the occipital furrow is not so direct, while the posterior glabellar furrows are more oblique: the second or median pair of furrows can be traced across the glabella, while the anterior ones are slight indentations in the margin, like the anterior and middle ones of *D. pepinensis.* The dorsal furrow is more sharply impressed at the sides; turning rectangularly in front of the glabella, which is more truncate, and separated by a narrower furrow from the more convex frontal limb.

These features are important distinctions, since in this one the approach to the Genus CONOCEPHALITES, in the form of glabella and glabellar furrows, is very perceptible. The pygidium has the general expression of *D. minnesotensis*, being somewhat more convex, but the minor characters are very different.

This species occurs at Trempaleau in calcareo-magnesian sandstone, near the middle of the formation.

DIKELOCEPHALUS MISA (n. s.).

PLATE III, FIG. 15; AND PLATE V, FIGS. 4, 5, and ? 6, 7 & 8.

Glabella prominent, somewhat conical, truncate at the apex, the length about equal to its width at base, which is more than one-third greater than the width in front. Three pairs of furrows are visible; the posterior ones oblique and sometimes slightly marked across the middle, leaving the posterior lobes deeply separated and directed forward at the extremities. Median lobes and furrows directed a little forward; anterior furrows faintly impressed, leaving a very narrow anterior lobe; occipital furrow well defined, straight in the middle, and curving a little upwards at the sides: occipital ring wider in the middle, curving forward towards the extremities.

Facial suture directed slightly inwards from the anterior margin, and thence curving gently outwards, it follows the line of the palpebral lobe nearly to the occipital furrow, when it turns abruptly outwards. Dorsal furrow rather wide and deep, continuing a little less distinctly around the front.

Fixed cheeks narrow, expanding in the direction of the eye, and separated from the palpebral lobe by a long distinct sigmoid groove: posterior limb narrow, its extent unknown. Frontal limb of moderate width separated from the glabella by a narrow groove, marked along the middle by a shallow transverse furrow, which is stronger at the sides and sometimes nearly obsolete in the middle; anterior margin flattened, and a little produced in the middle.

The characters here given are pretty constant in several specimens: the prominent lobed glabella, broad dorsal furrow, and narrow fixed cheeks, are distinguishing fea-

tures. The posterier glabellar furrows are sometimes continued in a slight depression across the centre. The frontal limb is sometimes, but not always, a little produced in the middle, and a shallow furrow is always perceptible.

A well-formed specimen gives the following measurements: Length of glabella, 0·30 of an inch; width at base, 0·29; width at apex, 0·22; frontal limb, 0·12; entire length of head, 0·48.

A pygidium in the same association, and apparently belonging to this species, has the anterior margin much curved, the axis very prominent, and the lateral lobes convex near the axis, concave and flattened towards the margins. The axis is marked by four annulations, exclusive of the anterior ridge: the posterior one is elongate, and apparently indented about the middle of its length. The lateral lobes have three or four ribs, which are longitudinally divided, and terminate in a flattened border: the divisions are narrow and prominent.

In species like this one, it is not easy to point out the characters which separate them from such forms as *Dikelocephalus spiniger* or *D. pepinensis;* and we have the features of glabella intermediate between the more characteristic forms of Conocephalites and Dikelocephalus. In this one the glabella is more conical, and the posterior glabellar furrows scarcely united across the summit.

The pygidium which occurs in several specimens associated with the glabella, has the prominent axis and broad lateral lobes with wide margin which are characteristic of the Dikelocephalus, and I am therefore induced to place the species under that genus.

This species occurs in the second fossiliferous beds at Trempaleau, and in the greenish sandstone near the same horizon at Miniska, about the middle of the formation.

DIKELOCEPHALUS OSCEOLA (n. s.).

PLATE V, FIG. 18; AND PLATE II, FIG. 49?

HEAD small in the specimens observed, having a length of less than half an inch.

GLABELLA with the sides nearly parallel, slightly narrowing anteriorly, truncate in front. Occipital furrow narrow and well defined: occipital ring of the same convexity as the glabella, and of equal width throughout. Posterior glabellar furrow sharply defined in the cast, and extending in a backward curve entirely across and terminating a little in advance of the centres of the palpebral lobe: the second furrow slightly marked on the sides of the glabella. Dorsal furrow narrow and well defined in the posterior part, slightly marked in front.

FIXED cheeks narrow, expanding towards the eye: palpebral lobe limited by a distinct groove, which, in its posterior inward curve, extends to a point opposite the extremity of the occipital ring. Frontal limb of moderate width, extending in front of the glabella in a broad depression, which is nearly flat in the bottom, and thence rising abruptly in a narrow marginal rim.

This species has been observed in three imperfect specimens of the head. It resembles in general features specimens of the three preceding species (*D. pepinensis*, *D. spiniger*, and *D. misa*); but is distinguished from all of them by the wide depression in front of the glabella, and the abruptly elevated narrow border. These specimens have the characteristics of the Genus DIKELOCEPHALUS, as shown in all the preceding species. It occurs in the sandstone at Osceola mills, associated with ILLÆNURUS.

A small glabella associated with this one does not show the second pair of furrows: it is more sharply truncate, and a little wider in front; the frontal limb is shorter; the depression anterior to the glabella is narrower, and the marginal rim a little stronger and very

straight in front. This specimen and the others are associated with a pygidium described below.

A PYGIDIUM (of this species?, Plate ii, f. 49) has the axis comparatively narrow and abruptly elevated, marked by six annulations besides the anterior articulating segment. The lateral lobes are marked by about four ribs, besides the anterior segment.

The anterior margin of the pygidium is extremely curved, and the antero-lateral angles are produced into long curving spines which are as long as the body of the pygidium. The posterior margin between the spines is rounded, and the ribs terminate in a continuous thickened border.

At least five individuals of this peculiar species have been seen. The figure is twice enlarged, from a cast made in the natural mould in sandstone, associated with the glabellæ described above.

GENUS CONOCEPHALITES (ZENKER).

I have referred to this genus several species heretofore placed under DIKELOCEPHALUS and LONCHOCEPHALUS by OWEN; restricting the former designation to the typical species of that author, which are certainly very distinct from some of the others described under that genus. Those species with the more conical and highly arched forms of glabella were in part designated by DR. OWEN as LONCHOCEPHALUS, of which one character is the long spine projecting from the base of the glabella.

The generic description of LONCHOCEPHALUS is as follows: "*Generic character.* In this small and singular genus the "highly arched glabella is either undivided, or has only "two very obscure furrows. A spine of greater or less "length projects backwards from the base of the gla- "bella, in the median line of the body over the thoracic

"segments (fig. 12, Tab. I A). The pygidium found "associated in the same beds is semilunar, with little "or no border, and has four segments of the axal lobe."

The Genus CREPICEPHALUS was created for other forms, of which DR. OWEN speaks as follows:

"The rather flat slipper-shaped glabella is tapering and "slightly acuminated anteriorly, with a faint ridge in "the median line: two small and very superficial de- "pressions, and a posterior faint furrow, very partially "divide the glabella. The facial sutures run nearly "parallel to the margin of the glabella, and join a "thickened cordlike anterior narrow border, enclosing "a convex area, narrower in front than at the sides. "Oblique plications can sometimes be traced on the "cheek-plate in advance of the eye, converging towards "the apex of the glabella."

We observe here also characteristics of the Genus CONOCEPHALITES in the conical glabella with obscure furrows, and the ocular ridges in the obliqe plications, etc.; while the only *species* designated by Dr. OWEN (*C. wisconsensis*) has a wide frontal limb, and offers no means of distinction in the head from one species placed under the Genus LONCHOCEPHALUS (the *L. hamulus*).

It is difficult and perhaps impracticable to sustain these genera, or either of them, upon the characters here given; though it must be admitted that there is some difficulty in referring all these species to CONOCEPHALITES, when we restrict the signification to such forms as the *C. sulzeri* and *C. striatus*.

In several of our species the glabella is very depressed convex, and the oblique furrows are wanting or very obscure. It must be stated, however, that we are dealing with the casts of the interior, and therefore these markings are necessarily obscure. The presence of spines from the occipital ring cannot of course be regarded as of generic

importance, while the caudal spines in one species may perhaps be admitted as unobjectionable in CONOCEPHALITES. At the same time many of the thoracic segments associated with the cephalic shields having the characters noticed, are not like those of CONOCEPHALITES. On the other hand, instead of terminating abruptly at the extremities, they are suddenly bent backwards in an elongated spiniform extension very similar to the segments in PARADOXIDES. Other forms, both of the head and of the thoracic segments, bear some characters in common with OLENUS.

When we look at the course of the facial suture, the form and proportion of the eyes, we find them varying from the characters of CONOCEPHALITES as exhibited in the species cited above.

In the last named characteristics, many of our western species correspond more nearly with the *C. emmerichi* of BARRANDE, which likewise has a node on the occipital ring. Were it not for the extension of the pleura, we would find no difficulty in the comparison with this European species. This feature of the thoracic segments would demand an extension of the characters of CONOCEPHALITES, or the admission of a separate genus; in which case, to avoid the multiplication of synonymy, I would suggest that one of the names proposed by Dr. OWEN be adopted.

I hesitate at the present time to separate these forms from CONOCEPHALITIES, because the material, being all fragmentary and in the condition of moulds or casts, may not carry with it the conviction to the minds of naturalists, that it otherwise might do. The glabella, moreover, with the fixed cheeks, being referable to forms of similar character to *C. emmerichi*, offer, in these parts, the greatest analogy with CONOCEPHALITES.

CONOCEPHALITES MINOR (SHUMARD).

PLATE III. FIGS. 1–4.

Conocephalites minor: SHUMARD, Trans. Acad. Sciences of St. Louis, Vol. ii, p. 105.

"Very small. Glabella well defined by linear dorsal furrows, subcircular, much elevated above the cheeks, regularly convex, slightly longer than wide, marked on either side with two short deep lateral furrows, which are directed obliquely backwards, and reach not quite one-third the distance across: neck-furrow linear, distinctly but not deeply impressed, sinuate, arched forward in the middle; neck-segment short triangular, gently convex, not elevated, posterior angle terminating in a delicate acicular spine which is prolonged backwards, its length unknown; front margin narrow, convex; cheeks rounded, having very delicate ocular ridges, which pass from the eyes in a short curve to reach the glabella a short distance in advance of the anterior glabellar furrow. Length of head, 0·10 of an inch; length of glabella, 0·08."

Among a large number of specimens in my collection, which I have referred to this species, there are some varieties of form. A single specimen of the head destitute of cheeks, which was kindly sent to me by Dr. SHUMARD, from near the mouth of Black river, has a more rotund form, and the glabella is proportionally shorter than in specimens from Trempaleau, before regarded as undescribed, but which I have now identified with the species of Dr. SHUMARD. The sandstone of the Black river locality is of somewhat different character, finer and more compact; and the difference in form may be due only to physical conditions.

In the Trempaleau specimens the glabella is ovoid and very gibbous; the width and length to the occipital furrow about as three to four, varying slightly in different specimens, some of which are proportionally longer. The lateral furrows reach about one-third across the glabella. The anterior furrow is short and slightly oblique: the middle furrow is more deeply impressed, and the posterior furrow is more oblique and deeper, separating the posterior lobe so that sometimes it appears like an ovoid tubercle. The occipital furrow is either direct or a little arched forward, sharply impressed: the occipital ring is short, triangular, and extended posteriorly into a slender sharp spine, which, including the segment, is about as long as the glabella. The dorsal furrow is strongly defined, limiting the glabella as distinctly in front as at the sides. The fixed cheeks are narrow, convex or rounded longitudinally, a little wider anteriorly, rarely showing ocular ridges: the posterior limb is much extended. The frontal limb is convex, narrower than the cheeks, marked by a sharp groove, and terminated by an equally sharp, straight, narrow border. The movable cheek is small, broadly triangular, with a well-defined border which is prolonged into a short spine, and on its inner angle supports a prominent occuliform tubercle.

The caudal shields associated with this species are small, somewhat semicircular or paraboloid, with the axis prominent and marked by about six rings. The lateral lobes show four distinct ribs, which terminate in a narrow border.

Well-formed specimens measure, from the neck-furrow to the anterior limb, about 0·12 of an inch; the glabella being 0·10 of an inch in length, and about 0·07 of an inch in width.

The figures 1, 2, 3, 4, are views of the glabella and fixed cheeks, a profile of the same, a separated movable cheek, and a pygidium, which are all four times enlarged.

This small species is very common in the sandstone at Trempaleau, associated with *C. iowensis*, *Lingula ampla*, *Obolella ?* and *Pugiunculus* or *Theca*. Dr. SHUMARD cites the *Conocephalites* (*Lonchocephalus*) *chippewaensis* as occurring in the same association, near the mouth of Black river on the Mississippi. The original *C.* (*L.*) *chippewaensis* of OWEN is cited by the author as from the *fourth* or Marine-mills trilobite bed, while the *C. minor* is in the *lower* trilobite bed.

The following species of CONOCEPHALITES is from the Potsdam sandstone of New York :

CONOCEPHALITES MINUTUS.

PLATE III. FIGS. 5, 6 & 7.

Conocephalites minutus: BRADLEY, Am. Jour. of Science, Vol. xxx, p. 241. 1860.

HEAD semicircular, somewhat straight in the middle of the front, with the posterior angles of the cheeks produced into spines which are more than half as long as the cheek-shields.

GLABELLA very gibbous, ovate conical, a little longer than the width at the base, slightly narrowed behind; marked by three pairs of glabellar furrows, the anterior ones being usually obscure: occipital ring prominent in the middle, and produced into a spine, which, measuring from the occipital furrow, is about three-fourths as long as the glabella. Occipital furrow narrow and well defined. Dorsal furrow narrow, somewhat sharply defined, and continued of the same strength in front of the glabella.

FIXED cheeks comparatively wide, with the posterior limb short: ocular ridges distinct, reaching the dorsal furrow just behind the anterior glabellar furrow. Frontal limb extending, with a thickened and elevated anterior border which is a little wider in the middle.

MOVABLE cheeks narrow, with ocular sinus comparatively large: the border is thickened and produced in a slen-

der extension in front, and posteriorly produced into a distinct spine.

This species is given in this place for comparison, since it has been regarded as identical with the *C. minor* of Wisconsin. They are much alike, and, on cursory examination, might not be distinguished. From specimens which have been kindly given me by Mr. BRADLEY, the form of glabella and fixed cheeks have been determined, and a figure of the movable cheek has subsequently been added to the plate from a specimen in Mr. BRADLEY'S collection.

The figures are four times enlarged. The greater width of the fixed cheeks, and the smaller movable cheek of this species, are distinctive features. The straight anterior border and wide fixed cheeks give the aspect of OLENUS to the frontal limb.

FIG. 5. The glabella and fixed cheeks of *C. minutus*, four times enlarged.
FIG. 6. Profile of the same.
FIG. 7. A movable cheek of the same.

This species occurs in the Potsdam sandstone at Keeseville, N. Y.

CONOCEPHALITES EOS (n. s.).

PLATE II, FIGS. 24 & 24; AND PLATE III, FIGS. 8 & 9.

GLABELLA very gibbous, width at base equal to its length from the occipital furrow; sides curving and gently narrowing anteriorly: anterior extremity abruptly rounded at the angles, and slightly curving in front. The posterior furrow is obliquely curved, reaching nearly to the base of the glabella, leaving the posterior lobe as a prominent node. The middle furrow is less distinct, slightly curving, and reaching nearly one-third across the glabella. The anterior furrow is not visible in the cast. The occipital furrow is comparatively broad, deep and well defined, curving forwards at the extremities: occipital ring, very convex, rounded, and a little more elevated than the back part of the glabella.

Dorsal furrow deep and strongly defined, particularly in the middle of its length: fixed cheeks very narrow at the sides, and arching longitudinally; the palpebral lobe separated from the cheek by a long sigmoid groove which reaches nearly to the groove in the posterior limb: the latter is broad, and the border narrow. The frontal limb has a wide and deep groove in front of the glabella, with an abruptly raised narrow anterior border, the whole being curved suddenly downwards at the anterior lateral angles.

This species is conspicuously distinct from any of the others by its very gibbous glabella, which is nearly equal in length and width. The posterior and medial glabella-furrows are well marked, but there is no distinct indication of the anterior one.

Specimens containing this fossil were derived from a loose mass of sandstone at Trempaleau, apparently from the beds near the locality, since it was little worn. From the character of the rock, its position is probably between the extreme lower and middle fossiliferous beds.

The three preceding species have the form of glabella which is characteristic of Conocephalites, and the facial suture cuts the frontal contour at a point distant from the apex. In the last one, however, the direction of the suture-line in its posterior course is different from the others, and there is a distinct groove defining the palpebral lobe; a feature not observed in the other two.

In the following species, the glabella is conical, and more or less distinctly marked by oblique furrows. The suture-line partially cuts the anterior border at a point distant from the apex, but a narrow portion of the cheek-border extends along the frontal limb nearly or quite to the apex. This course of the suture-line produces a sloping or curved outline from the apex to the lateral margin of the frontal limb. The fixed cheeks are very narrow, and prominent towards the eye; but in none of them are

there well-marked ocular ridges, and the palpebral lobe is not observed to be distinctly limited by a groove, except in *C. anatinus*. In the latter character there is no departure from typical CONOCEPHALITES; but in the course of the suture-line in front, there is a departure from the recognized species of that genus.

The species thus grouped are the *C. perseus*, *C. shumardi*, *C. nasutus*, *C. oweni*, *C. eryon*, *C. anatinus*, and *C. patersoni*.

Among the remains of some of these species we find the "*doublure*" or lower border of the frontal limb, separated as a single piece; presenting a feature somewhat similar to the corresponding part of PARADOXIDES, except that its continuity on the posterior margin is not broken by the attachment of the hypostoma. This portion of the front, however, has a distinct, central, vertical suture, as in ASAPHUS (See fig. 38 *a*, Plate II).

Should the species possessing these features be found to require separation from CONOCEPHALITES, I would propose the name CONASPIS.

CONOCEPHALITES PERSEUS (n. s.).

PLATE II, FIGS. 17–23; AND PLATE III, FIG. 33.

GLABELLA cylindrico-conical, gibbous, rounded at the anterior extremity. Glabellar furrows very distinct; the posterior furrows oblique and deeply impressed, and extending across the glabella: the second furrows are nearly rectangular to the axis, distinct at the sides, and extending almost across the glabella; anterior furrows obscure or obsolete, and close to the anterior extremity, the anterior lobe very short. Occipital furrow comparatively deep, curving forward in the middle and at the extremities: occipital ring as high as the posterior part of the glabella, or sometimes a little higher. Dorsal furrow sharply and neatly defined, and its continuation in front almost as well marked as at the sides.

Facial suture vertical in its anterior line, curving at the prominent palpebral lobe, and making a sharp curve outwards at its lower angle.

Fixed cheeks narrow; palpebral lobe prominent; posterior limb narrow triangular; frontal limb short and traversed in the middle by a deep groove, from which the narrow anterior margin rises abruptly: outline in front a little produced in the middle. The centre of the palpebral lobe is opposite the middle of the glabella. In the very gibbous form of the glabella and deeply marked posterior furrows, which are united across the middle, and in the narrow and deeply grooved frontal limb, it differs from any of the species described.

A pygidium associated with numerous specimens of the glabella is nearly semicircular, slightly curved on the anterior margin, with a narrow prominent axis which is marked by three or four annulations besides the terminal one, the latter bearing two obscure nodes. The lateral lobes are scarcely convex, with about three divided ribs.

This species occurs on the Mississippi river, opposite the mouth of the Chippewa, associated with *Conocephalites diadematus* and *Arionellus bipunctatus*. It likewise occurs in gray ferruginous sandstone at Kickapoo, associated with *C. shumardi;* differing from that one conspicuously in its more cylindrical glabella.

CONOCEPHALITES SHUMARDI (n. s.).

PLATE II, FIGS. 1 & 2; AND PLATE III, FIGS. 32 & 19?

Glabella broad, truncate-conical, width at base greater than the length, convex, gibbous in the middle, and in large specimens a little flattened or depressed-convex on the sides. Posterior furrows oblique, leaving a large prominent posterior lobe; middle furrow oblique and deeply marked; anterior furrows shorter and less oblique, leaving a small anterior lobe. Occipital furrow somewhat strongly defined, straight in the central part,

curving forward at the sides: occipital ring curving forward, wider in the middle. Dorsal furrow strongly marked at the sides, deeply indented at the anterior angles of the glabella, and continued in front of the same depth as at the sides.

Facial suture vertical in front of the eye, meeting the anterior angle of the palpebral lobe opposite the anterior glabellar furrow. The palpebral lobe extends as low as the posterior glabellar furrow, whence the suture turns outwards and obliquely downwards.

Fixed cheeks of moderate width, and, in larger specimens, distinctly marked by ocular ridges which extend from the anterior glabellar furrow to the anterior margin of the palpebral lobe: the posterior limb is comparatively broad, triangular. Frontal limb of medium width, rising somewhat abruptly from the furrow in front of the glabella, and forming a rounded, more or less prominent ridge, descending into a subcentral groove, from which the anterior border rises abruptly, forming a narrow ridge which is a little wider in the middle than at the sides.

This is a well-marked species, preserving its distinguishing features even in the smallest specimens. It is remarkable for the great width of the glabella at its base, the strong glabellar furrows, and truncate apex; while the prominent ridge in front of the glabella, with the anterior furrow and sharply elevated margin, are peculiar. The ocular ridges, conspicuous in the larger specimens, are observable in the smaller ones.

A small specimen gives the following measurements: Length of glabella, .18 inch; width at base, between .19 & .20; width at apex, .11; frontal limb, .09. Entire length, .32 inch.

Several larger specimens are imperfect; one of them being nearly twice as large as the one measured.

This species occurs, in numerous small specimens, in the ferruginous gray sandstone at Kickapoo, Wisconsin, associated with *Conocephalites nasutus* and *C. diadematus*. In one specimen from a different bed, there is a single individual of twice the ordinary

size. Numerous specimens of considerably larger size than the ordinary forms at Kickapoo have been found at Marine mills on the St. Croix river, associated with *C. oweni.*

CONOCEPHALITES NASUTUS (n. s.).

PLATE II. FIGS. 3–9.

A SMALL species with a somewhat broad head. Glabella short, truncate-conical, somewhat abruptly convex, the length equal to the width at its base; the posterior and middle furrows oblique, and somewhat deeply marked; the anterior one near the front of the glabella, and often inconspicuous in small individuals. Occipital furrow somewhat wide and deep, straight in the middle, making a slight curve backwards, and thence forward at the extremities: occipital ring rather broad in the middle and narrower at the sides. Dorsal furrow linear, well defined, and extending with the same strength in front of the glabella, which rises abruptly, while the cheeks are nearly flat.

FIXED cheeks narrow, elevated in the direction of the palpebral lobe: posterior limb narrow triangular: frontal limb extended, scarcely convex, and sloping downwards from the glabella for two-thirds the length, where it is marked by a transverse furrow, beyond which it is contracted at the sides, a little convex in the middle and attenuated towards the anterior margin.

The movable cheek (of this species?) somewhat elongate, gradually narrowing to the posterior extremity, which is produced into a lightly curved spine of moderate length. The facial suture reaches to the base about one-third the distance from the marginal rim to the eye.

This species is abundant in the gray and ferruginous sandstone of Kickapoo. It is pretty uniform in its characters, and easily recognized by the pinched and nasute anterior portion of the fron-

tal limb. The posterior portion of the limb is sometimes scarcely convex, and in others it is elevated in a convex band. In its short broad truncate-conical glabella it resembles *C. shumardi;* but in that species the cheeks are more elevated towards the eyes, and the anterior margin of the frontal limb is abruptly elevated into a sharp narrow ridge, the dorsal furrow is deeply pitted at the anterior angles of the glabella, and the glabellar furrows more deeply impressed.

The species associated with this one are *C. diadematus*, *C. shumardi* and *C. perseus*.

CONOCEPHALITES OWENI (n. s.).

PLATE III. FIGS. 17 & 20.

Glabella ovate-conical, the width at base equaling or a little less than its length from the occipital furrow, regularly convex and gently curving in front. Posterior glabellar furrows extremely oblique, the middle ones less so, and reaching not more than one-third across; the anterior furrows not distinctly seen. Occipital furrow shallow, of equal width throughout, or sometimes nearly obsolete at the extremities and a little wider in the middle: occipital ring having about the same convexity as the back part of the glabella. Dorsal furrow well defined, not sharp or deep, and continuing of the same depth in front of the glabella.

Fixed cheeks narrow. The line of the facial suture, from the front contour, is nearly vertical (with the exception of the palpebral curvature) to the posterior glabellar furrow, whence it turns obliquely outwards, leaving a narrow posterior limb, which has a lateral extension two-thirds as great as the width across the axis at the occipital ring: frontal limb regularly convex, and curving abruptly downwards in front.

Movable cheek moderately convex, more than half as wide as long, with regularly curving outer margin and thick-

ened border which is produced anteriorly, and the posterior extremity extends in a slender spine. Sinus, formed by the eye-tubercle, of medium size.

In two specimens, carefully measured, we have the entire length of glabella 0·30 of an inch; width of glabella at base, 0·29; at apex, 0·18; entire length of head, 0·44; frontal limb, 0·10 of an inch. In another specimen, these measures are respectively 0·25, 0·23, 0·14, 0·38, 0·09.

This species, in its glabella and frontal limb, somewhat resembles *C. eryon* (fig. 16), but the proportions are somewhat different: the glabella is narrower at base and much more convex; the frontal limb is not quite so extended, and is more convex; the facial suture continues its vertical direction farther down, leaving a narrower posterior limb of the fixed cheek.

The heads and cheeks of this species, in the condition represented on the plate, occur in myriads in certain layers at Marine mills: the slabs are covered with these, and remains of two other species which are comparatively rare. This position, according to Dr. OWEN, is above the middle of the Sandstone series in the Fourth Trilobite bed.

The *Conocephalites* (*Lonchocephalus*) *chippewaensis* of OWEN is cited by that author as occurring in the fourth or Marine mills Trilobite grit; and before I had critically examined this one, I supposed the smaller specimens to be the same. After having studied numerous specimens without finding evidence of a spine from the occipital ring (that being a conspicuous feature of the *C. chippewaensis*), I am constrained to refer the specimens to some other species. Most of the specimens, moreover, are much larger than the figures of Dr. OWEN.

In some of the slabs from Marine mills there are spines which appear to have belonged to the posterior part of the head of some trilobite, and these may possibly belong to the species of Dr. OWEN which I have failed to procure. Some of the species appear to be restricted to a very limited range, and it is quite probable that my specimens are from a different layer than that in which *C. chippewaensis* occurs.

CONOCEPHALITES ERYON (n.s.).

PLATE II, FIGS. 10–16; AND PLATE III, FIGS. 16–31.

Specimens consisting of the glabella and fixed cheeks, with imperfect movable cheeks and pygidium.

Glabella ovate-conical, a little wider at base than the length from the occipital furrow, depressed convex, arcuate: sides gently curving on the lower half and more rapidly above, slightly truncated anteriorly: furrows oblique and faintly marked, extending more than one-third across; the anterior one usually imperceptible, and the others frequently obscure. Occipital furrow shallow and not sharply defined in the middle, deeper and more strongly defined at the sides: occipital ring not elevated above the general convexity of the glabella, somewhat triangular in form, projecting backwards in the middle.

Facial suture nearly vertical from the front to the eye-lobe, which is anterior to the middle of the glabella: behind this it makes a slight curve and extends backwards, making an angle of about 60° with the line of the axis.

Dorsal furrow very shallow at the sides, and continued less distinctly in front of the glabella; the fixed cheeks being little elevated, and the glabella rising more abruptly. The fixed cheeks are narrow in the upper part, elevated in the direction of the eye, but the palpebral lobe is not well defined; the lower limb broadly triangular, with a shallow posterior furrow; the frontal limb broad, depressed convex and arching downwards in front, and transversely marked by a shallow groove about one-third its length from the front.

More than one hundred individuals of this species have been observed on a single slab of stone, and the characters are well preserved from the smallest specimens to the largest one.

The entire length of the head of a large specimen is 0.65 of an inch.

Length of glabella	0.35	..
Width of glabella at base	0.37	..
Width of glabella in front	0.18	..
Length of frontal limb	0.12	..

One of the smaller specimens has the entire length of head 0.11 of an inch.

This description of the species is taken from numerous specimens obtained at Trempaleau; while a single specimen from near Lacrosse (Plate iii, f. 31), with the same proportions, has the glabella more bent downwards in front, and the sides are more indented by the furrows, only two of which are distinctly seen. The fixed cheeks are precisely as in Trempaleau specimens.

A separate cheek, apparently of this species, is subtriangular, depressed convex, a little prolonged in front and apparently obtuse behind, with a thickened border and small eye.

A pygidium, associated with these specimens, is short and wide, with a strong prominent axis, which has three distinct annulations besides the anterior one, with two or three distinct ribs on the lateral lobes. The entire width is 0.47 of an inch, and the length 0.21; the axial obe being 0.19 of an inch wide.

CONOCEPHALITES ANATINUS (n. s.).

PLATE II, FIGS. 34 & 35; AND PLATE III, FIG. 29.

Glabella depressed-convex, subovate-conical, slightly subangular along the middle, rounded anteriorly, the sides curving, the base nearly straight, length a little greater than the width at base. Furrows shallow and often indistinct: occipital furrow narrow and shallow; occipital ring comparatively wide, flattened on the top, a little higher than the base of the glabella; dorsal furrow shallow, and continued in front of the glabella.

Facial suture making a gentle curve outwardly from where it cuts the contour in front, and thence nearly straight to the anterior margin of the palpebral lobe, and slightly curving outwards again returns beneath the eye, almost to the dorsal furrow, and then turns very abruptly outwards.

Fixed cheeks very narrow, spreading a little in the middle, and separated from the elongate palpebral lobe by a shallow groove: posterior limb narrow. Frontal limb extended, with a shallow depression close to the glabella, beyond which it is very gently convex and rounded at the extremity.

This species is peculiar, and very well marked in the curving anterior margin of the frontal limb, the elongate palpebral lobe, and the shallow narrow dorsal furrow, which is sometimes scarcely distinct.

Associated in the same specimens with these glabellæ there are several movable cheeks and other parts of the body, which may belong to this species. All the cheeks have the facial suture terminating at some distance within the posterior angle, which is extended in a long curving spine. The inner angle is marked for a very large eye-tubercle, corresponding to the elongate palpebral lobe.

A single pygidium in the same association has a short elevated axis, with only two or three rings visible: the lateral lobes are somewhat flat, marked by about three ribs which terminate in a broad flattened border. Some separated articulations of the lateral lobes of the thorax are marked by a broad groove gradually narrowing to the distal extremity, which is obtuse.

This species occurs in a ferruginous sandstone, above the lowest trilobite bed on the shores of Lake Pepin. In a single specimen, of five inches square, there are at least a dozen individuals. The glabella and cheek of Plate ii, figs. 45 & 46, are from this specimen. The small specimen, Plate iii, f. 29, is from a different layer, at Trempaleau.

CONOCEPHALITES PATERSONI (n. s.).

PLATE II. FIGS. 45 & 46.

Glabella ovate-conical, depressed-convex and slightly subangular along the median line, rounded in front, slightly contracted opposite the eye-lobes, a little longer than its width at the base; marked by three shallow

oblique furrows which are faintly impressed in the mould, the anterior one being near the front of the glabella. Occipital furrow slightly impressed at the sides, and not visible in the centre: occipital ring narrow at the sides, wider and more elevated in the middle (but without appearance of a spine). Dorsal furrow shallow, faintly impressed at the sides, and, in old specimens, not defined in front of the glabella.

Fixed cheeks narrow in the middle, gradually expanded towards the front, and curving regularly below into the narrow posterior limb: palpebral lobe not preserved in the specimens described; ocular ridges extending obliquely across the fixed cheeks; frontal limb much extended, nearly three-fourths as long as the glabella, plain and gently curving downwards, a little more prominent in the middle, and without transverse ridges or furrows.

Although but two individuals of this species have beenob tained, the characters are so peculiar as to leave no doubt as to its specific distinction. The glabella is scarcely separated from the frontal limb in the larger individual, and the latter is very long and quite free from ridges or furrows, a character not observed in any other species, A similar extent of frontal limb exists in *C. diadematus*, *C. wisconsensis* and *C. hamulus;* but in these it is marked by furrows or ridges, and connected with a different form of glabella which is limited by a frontal furrow.

This species is associated with *Concephalites anatinus* in a ferruginous sandstone at Trempaleau, Wisconsin.

CONOCEPHALITES? BINODOSUS (n. s.).

PLATE II. FIG. 47.

A small pygidium occurring in the sandstone at Osceola mills, differs from any of those before noticed. The axis is short, strong, and abruptly elevated, with three rounded annulations besides the terminal one, which is marked by two distinct nodes: these nodes may have been spines in

the original crust. Lateral lobes with three ribs besides the anterior one: ribs divided by a groove.

The cheek, fig. 48, was found in the same association.

Up to this time, no glabella of CONCEPHALITES has been found in the specimens from Osceola mills, and the pygidium is referred to that genus on account of its similarity to some in the preceding group of species. The pygidium associated with *C. perseus* is slightly binodose on the posterior annulation, but its form and the proportions of its parts are very different.

There are, besides those above described, a group of species with a moderately convex (rarely more prominent) glabella, which in some of them is angular along the middle, with faint glabellar furrows. In several of the species, the facial suture apparently cuts the anterior border at a distance from the apex; and with narrow fixed cheeks, they have a prominent palpebral lobe limited by a distinct groove, while the posterior limb of the fixed cheek is comparatively narrow. These species might be referred to DIKELOCEPHALUS, but for the conical glabella, and obscure furrows which do not extend entirely across it. Three of the species which appear to be thus related, have been designated by DR. OWEN respectively as DIKELOCEPHALUS, LONCHOCEPHALUS, and CREPICEPHALUS. Should a separate designation be required for these, I would suggest the adoption of the generic name LONCHOCEPHALUS.

The species bearing the characters above indicated are the *Conocephalites winona*, *C. iowensis*, *C. wisconsensis*, *C. hamulus* and *C. diadematus*.

The last named species has a more prominent glabella than the others, and is more strongly marked by the glabellar furrows, while the palpebral furrow is less distinct. The *C. iowensis* presents some distinctive features which may render necessary its ultimate separation from the genus.

CONOCEPHALITES WINONA (n. s.).

PLATE II. FIGS. 26–28.

Compare *Conocephalites chippewaensis* (= ? *Lonchocephalus chippewaensis*, Owen); Shumard in Trans. Ac. Sciences of St. Louis, Vol. ii, p. 164.

Head small. Glabella cylindrico-conical, sides gently curving towards the front which is regularly rounded, sharply truncate behind by a straight narrow occipital furrow: glabellar furrows obscure or obsolete. Occipital ring rounded lower than the glabella, narrow at the sides, and produced in the middle. Dorsal furrow abrupt, strongly defined at the sides and little less strongly in front: cheeks abruptly rising from the dorsal furrow, rounded above, and extended in the direction of the palpebral lobe. Frontal limb a little depressed below the plane of the cheeks adjacent to the glabella, and marked by a sharp transverse groove which is little less distinct than the dorsal furrow: and anterior to this the margin is elevated as high or higher than the part behind the groove. A slight central longitudinal groove or depression extends across the posterior part of the frontal limb, from the dorsal furrow to the frontal furrow.

Associated with numerous specimens of the glabella and fixed cheeks are many fragments of movable cheeks, and one or two nearly entire. The cheek is small, rather flat, with a strong thickened rounded border, which is prolonged into a spine as long as the body of the cheek. Eye large, semilunar, and abruptly elevated from the cheek.

Caudal shield (of this species?) nearly semielliptical, a little curved on the anterior margin: axis abruptly elevated, rounded, marked by about five annulations including the terminal one. Lateral lobes depressed convex, having three flattened simple ribs besides the anterior one, all terminating in a narrow flattened border.

One of the most marked features of this small species is the abrupt termination of the glabella behind; the lower angles not being rounded, while the occipital furrow is very trenchant. The glabella is less gibbous than in *C. minor*, and does not slope to the occipital furrow: the occipital ring is narrower, not triangular, and less produced posteriorly; the cheek is narrower, the border stronger, and the eye larger. In the caudal shield, the axis is more prominent, the lateral lobes more convex, and the ribs less elevated without perceptible grooves.

This species is associated with *C. iowensis*, OBOLELLA? and LINGULA, on the banks of the Mississippi opposite the mouth of the Black river, in specimens received from Dr. SHUMARD.

CONOCEPHALITES IOWENSIS.

PLATE VII, FIGS. 29–33; AND PLATE III, FIGS. 10–12, & 30.

Dikelocusephal iowensis: OWEN, Geol, Rep. of Wisconsin, Iowa and Minnesota, page 575, Tab. I, f. 4, and Tab. I A, f. 13.
Conocephalites iowensis: SHUMARD, Trans. Acad. Sciences of St. Louis, Vol. ii, p. 104.

Dr. SHUMARD also gives the following synonymy:

Crepicephalus: OWEN, Ibid. Tab. I A, f. 10, 16 & 18.
Undet. Trilobite: ID. Ib. Tab. I A, f. 11.
Lonchocephalus: ID. Ib. Tab. I A, f. 15.

THE species is of medium or large size. Head depressed convex. Glabella truncate conical, moderately convex, the centre sometimes more elevated and longitudinally subangular in the middle, a little flattened on the sides, the length (excluding the neck-segment) equal to the width at the base, truncate in front, with the angles abruptly rounded: lateral furrows obscure, and apparently not existing in younger specimens. Occipital furrow linear, rather shallow in the middle, deeper and sharply impressed towards the extremities. The occipital ring has the same elevation and convexity as the base of the glabella, wider in the middle, straight on the

anterior edge, and converging on the posterior margin from the middle to the extremities. Dorsal furrows strongly but not abruptly impressed at the sides, and at the anterior angles of the glabella: the groove in front of the glabella is more shallow than at the sides.

Fixed cheeks rising gently from the dorsal furrow, moderately convex, not as high as the glabella. Posterior limb with a well defined furrow: palpebral lobes long reniform, and "separated from the cheeks by a strong sigmoid furrow." Frontal limb about one-fifth of the entire length of the head; "having a deep transverse groove a little in advance of the middle," with a strongly elevated and rounded or "cordlike" anterior margin.

Movable cheeks comparatively small, narrow elongate, with a thickened border which is prolonged into a slender spine. Eye tubercle large.

Thoracic articulations of moderate strength; having a simple groove which becomes gradually narrower towards the outer end, and dies out at the commencement of the recurving extremities.

Pygidium subquadrilateral, with strong but slender diverging spines from the posterior angles. The axis and lateral lobes, without the expanded border, are semicircular; the axis somewhat abruptly elevated, with five annulations: lateral lobes with five segments, including the anterior one. The border extends from the extremity of the anterior segment in a direction nearly vertical, or slightly expanding downwards: the posterior edge of the border extends below the termination of the axis about one-fourth the entire length of the pygidium.

The measurements of three individuals give following dimensions:

	I.	II.	III.
Length of glabella in front of occipital ring..	.23 in.	.46 in.	.63 in.
Width of glabella at base.....	.20	.47	.60
Width of glabella at apex	.13	.28	.37
Length of frontal limb.....	.09	.15	.18
Entire length of head.....	.37	.71.94	

The proportions continue very nearly in all the parts except the frontal limb, which, in the larger one, has but twice the length of the smaller one, while the other parts are about three times as great. Since we find similar fragments of thoracic segments, and portions of the pygidia associated in the same specimens with the glabella, I can have no doubt of their identity with *C. iowensis*.

The illustrations on Plate iii, f. 10 – 12, are from Trempaleau, and are of the largest individuals found there. Subsequently Dr. SHUMARD has sent to me specimens of the glabella and fixed cheeks of several individuals from Black river, which are much larger. These are illustrated on Plate ii, f. 30.

At the mouth of Root river this species occurs of much larger dimensions than the specimens of Trempaleau, and considerably larger than those from the Black-river locality. The Root-river beds are apparently somewhat higher in the series than those of Trempaleau or Mountain island; but beyond this and one other species, I have not identified fossils from that locality.

The *C. iowensis* is a well-marked and very characteristic species of the lower fossiliferous beds of the Potsdam sandstone.

Dr. SHUMARD remarks that "this species may be readily distinguished from the *Crepicephalus* [*Conocephalites*] *wisconsensis*, OWEN, to which it is somewhat nearly allied, by its wider and more conical glabella, and much narrower front margin."

This fossil occurs with *Conocephalites minor*, LINGULA, OBOLELLA? and THECA, at Trempaleau; and in a similar association, near the mouth of Black river in Wisconsin. The larger specimens, from Root river, are associated with fragments of Trilobites, among which no other fossils have been observed.

CONOCEPHALITES WISCONSENSIS.

PLATE II, FIGS. 39-41; AND PLATE III, FIGS. 22, 23, 24, 27 & 28.

Crepicephalus? wisconsensis : OWEN, Geological Report of Wisconsin, Iowa and Minnesota, Tab. 1, f. 13. (The upper figure on the specimen, the lower figure being *Dikelocephalus granulosus*.)

Compare *Dikelocephalus latifrons :* SHUMARD, Trans. Acad. Sciences of St. Louis, Vol. ii, p. 101.

HEAD large. Glabella strong, truncate-conical, moderately convex, sometimes subangular in the middle, width at base nearly equal to the length; front usually

straight, sometimes a little curved; sides nearly straight and regularly converging: the posterior glabellar furrow oblique, and faintly marked; the middle one less distinct; the anterior one sometimes obscurely indicated near the anterior extremity of the glabella. Occipital furrow strongly impressed at the sides, but often faintly marked or scarcely perceptible in the middle. Occipital ring narrow at the sides, wider and inclining backwards in the middle, and rising to the base of a strong elevated spine, which is directed obliquely backwards, and in the course of its length is gently curved. Dorsal furrow well defined, not deep, a little more strongly impressed at the anterior angles of the glabella, and continued in front of the same strength as at the sides.

Facial suture curving slightly outwards from the frontal margin, and then gently curving towards the glabella at the anterior angle of the palpebral lobe, which is a little forward of the middle glabellar furrow; thence curving to the base of the eye, it is directed outwards.

Fixed cheeks narrow, with a narrow posterior limb; the palpebral lobe limited by a distinct groove: frontal limb much extended, and gently curving at the sides; the anterior border, for about one-third or nearly one-half its entire length, longitudinally flattened and ascending to the anterior margin, with a wide shallow furrow between it and the posterior gently convex portion of the limb. The shallow frontal furrow and posterior part of the limb are sometimes visibly striated, with flexuous interrupted lines which converge towards the glabella; and the bottom of the groove, in the cast, is sometimes marked by a row of granules or minute tubercles.

The wide frontal limb and strong curving spine of the occipital ring are characteristic features of this species. The glabella approaches in form that of *C. iowensis;* while the frontal limb of that

species is much narrower, and the fixed cheeks are wider and more elevated.

A movable cheek (Plate ii, f. 41), occuring in the same association (and with scarcely any fragments of other fossils), I have referred to this species with doubt.

There is also a pygidium in the same specimens, which I have referred to this species. It is more than twice as wide as long; the axis is conical, abruptly elevated, and marked by six annulations besides the anterior articulating joint. The sides are nearly flat, and marked by four ribs which are flattened and faintly grooved.

Dr. SHUMARD has very kindly sent me a specimen of the species described by him as *Dikelocephalus latifrons*, consisting of the large frontal limb and the principal part of the glabella (Plate ii, fig. 40). On comparison with seven or eight individuals of the species which I have identified with *Crepicephalus? wisconsensis* of OWEN, I can find no characters which separate the two. From its conical glabella and oblique furrows, I place it with CONOCEPHALITES. It is clearly related generically to *Lonchocephalus* (*Conocephalites*) *hamulus* of OWEN.

The great width of frontal limb shown in Dr. OWEN'S figure of *Crepicephalus wisconsensis* is a character not possessed in an equal degree by any other species except *Conocephalites hamulus*, and, approximately, by *Conocephalites diadematus*. The contour of the limb in the two last is different from that of the figure of Dr. OWEN, which corresponds with the specimens I have referred to that species. In the figure cited (Tab .1, f. 13), the frontal limb is equal in length to the width of the glabella near the front; a feature which corresponds with the specimens I have figured, and with others of the same species. In the specimen of Dr. SHUMARD, the length of the frontal limb is proportionally a little greater; but I do not regard this difference as of specific importance.

PLATE II.

FIG. 39. The glabella and fixed cheeks of a small individual.

FIG. 40. The frontal limb and part of the glabella of a large individual, showing radiating striæ on the frontal limb. This figure is from Dr. SHUMARD'S specimen.

FIG. 41. A cheek (associated with the glabella at Trempaleau), showing the direction of the facial suture in its posterior extension.

PLATE III.

FIG. 22. The glabella, preserving part of the fixed cheeks, frontal limb, and posterior spine.

FIG. 23. Profile of the same.

FIG. 24. Pygidium associated in the stone with the specimen fig. 22, and several other similar ones.

FIG. 27. A smaller specimen, presenting some slight variations from the preceding figure 22.

FIG. 28. Profile of the same.

This species occurs at Trempaleau, Wisconsin, and opposite the mouth of the Chippewa river in Minnesota, associated with *Ptychaspis granulosa*, *Agnostus josepha*, etc., in beds that I have recognized as the second fossiliferous group of the sandstone. The locality of Dr. OWEN'S specimen is not given; but from its association with *Ptychaspis* (*Dikelocephalus*) *granulosus*, I infer it to have been from near Trempaleau.

CONOCEPHALITES HAMULUS.

PLATE II, FIGS. 43 & 44; AND PLATE III, FIGS. 25, 26.

Lonchocephalus hamulus: OWEN, Geol. Report Wisconsin, Iowa and Minnesota, page 576, Tab.I A, f.8 & 12.

THE glabella, frontal limb and fixed cheeks, without the posterior limb; form a suboval figure, which is concave on the sides (fiddle-shaped).

GLABELLA subtruncate-conical, narrow, the length greater than its width at the base, subtruncate or slightly rounded in front; furrows very obscure, moderately convex, and sometimes subangular along the middle. Occipital furrow not deep, well marked at the sides, and shallow or obsolete in the middle: occipital ring wider in the middle, elevated above the base of the glabella, and produced into a long slightly arcuate spine.

FACIAL suture cutting the anterior margin in a nearly vertical line from the inner margin of the palpebral lobe; thence, making a gentle curve outwards, it returns to the same line just in advance of the eye, and thence to the posterior edge of the palpebral lobe, leaving a

very narrow posterior limb, the extent of which is unknown. Frontal limb extended about two-thirds as long as the glabella, depressed convex on its posterior half; thence gently curving downwards towards the front, it is marked a little in advance of the middle by a low ridge, on each side of which is an undefined furrow, leaving the anterior border a little narrower than the posterior convex portion.

This species differs fron the *C. wisconsensis* in the less lateral extension of the frontal limb, the narrow subcentral transverse ridge and shallow furrows, and in the proportionally longer glabella.

PLATE III.

Fig. 25. The glabella and part of the fixed cheeks, with frontal limb and posterior spine.

Fig. 26. Profile of same.

The remarkable spines, which occur in the same association, are represented on Plate II and on Plate VI, figs. 5 & 6. These appear more like cheek-spines than glabellar spines; but it is still impossible to assign to them their true relations, with our present knowledge of the parts of trilobites occurring in the same association. In some forms or conditions, as fig. 44 of Plate II, we might suppose them to be cephalic spines; but in the condition of fig. 6, Plate VI, we cannot so readily assign them a place; and this question becomes still more difficult of solution when we find them in the condition of fig. 5, where there is an expansion like a part of the cheek within the curve of the thickened border. These spines do not represent the posterior spines of the cheeks, for they have no groove on the upper side, or evidence of infolding of the crust on the lower side; but the thickened parts near the base are rounded above, slightly flattened below, and longitudinally striated, with that extremity sharply truncated as if by a suture. In the specimens fig. 5, there is, on what may be the posterior side, a narrow thickened border not unlike a cheek-border, with the impression of a thin expanded crust resembling a cheek-shield irregularly broken off along the inner margin.

We might suggest that the spine, like fig. 5, proceeded from the middle or anterior part of the movable cheek, near the facial suture,

curving outwards and backwards; and that the expanded crust within the thickened curving border below (which is broken on its inner margin) is a part of the cheek-shield near the posterior angle.

Although Dr. Owen has referred these spines to the same species with the glabella which he denominated *Lonchocephálus hamulus*, I have no evidence of such relation of the two fossils. While the spines are extremely numerous, the glabella (Plate iii, fig. 25, and Plate ii, fig. 43) is comparatively rare: neither do they seem related by the strength and proportions of the parts; for the glabella, frontal limb and occipital spine are comparatively slender, while the separated spines indicate a more robust animal.

The glabella is known only in the greenish gray sandstone beds at Miniska, where it is associated with the spines as described by Dr. Owen. Spines of the same character occur in the greenish and compact ferruginous sandstones at Trempaleau, much more numerously than at Miniska; but the glabella has not been found in the same association.

CONOCEPHALITES DIADEMATUS (n. s.).

PLATE II, FIGS. 36–39; AND PLATE III, FIGS. 18 & 21?

Head broad, moderately convex, with widely extended cheeks and frontal limb.

Glabella prominently convex, subovate-conical, about five-sixths as wide at base as its length from the occipital furrow, rounded or slightly subtruncate in front. Posterior furrow turning obliquely backwards; middle furrow less strongly marked; anterior furrow still less conspicuous, and in small specimens not distinguishable; occipital furrow shallow, well defined, and bending a little forward towards its extremities; occipital ring flattened, having the same elevation as the glabella, and of nearly equal width throughout. Dorsal furrow shallow, defined, little depressed below the plane of the fixed cheeks, which are flattened and much below the convexity of the glabella: the furrow is continued, though less strongly defined, in front of the glabella.

Fixed cheeks flat, half as wide as the glabella. In the larger specimens, a distinct ocular ridge extending from the palpebral lobe in the direction of the front of the glabella: posterior limb unknown. Frontal limb much expanded, with a narrow flattened space beyond the groove, and, rising abruptly, it spreads in a broad flattened border which is apparently not thickened upon its margin.

A movable cheek in the same association is elongate triangular, with a large ocular sinus: the posterior angle is produced into a long curving spine; the body of the cheek is convex, with a wide flattened border.

The measurements of the head are as follows: Length of glabella anterior to the occipital furrow, 0·36 of an inch; width at base, 0·30; width at the anterior end, 0·24; entire length of head, 0·61; frontal limb, 0·18 of an inch.

A pygidium, fig. 21, found in the specimens from Marine mills, which appears to be too large for any individual of *C. oweni*, I suppose may belong to this species. It is more than twice as wide as long; the axis abruptly elevated, and marked by six annulations, including the anterior one; the lateral lobes are nearly flat, and marked by three divided ribs besides the anterior one, all terminating in a flattened border. A single specimen, larger than this one, has been seen.

PLATE II.

Fig. 36. The glabella and part of the fixed cheeks, showing ocular ridges. (The specimen is of medium size, from Marine mills.)

Fig. 37. A part of a larger head, with the glabellar furrows more strongly marked.

Fig. 38. A cheek associated with fig. 37, and probably of the same species. The figure shows the course of the facial suture and the extension of the border on the lower side, which reaches beneath the frontal limb.

PLATE III.

Fig. 18. A glabella and frontal limb, in which the space between the front of the glabella and the elevated border is much narrower than in the other specimens.

Fig. 21. A pygidium which occurs in the same association.

This species is comparatively rare: a few individuals occur in some specimens from the Marine mills on the St. Croix river, with large numbers of *Conocephalites oweni*. It is very distinct from any other, in the depressed flattened area just forward of the glabella, and the abrupt elevation and flattened anterior border. There is considerable diversity of expression given to this species, from the greater or less extent of the depressed flattened portion of the limb in front of the glabella, and also from the imperfection of the anterior border of the limb, which sometimes leaves it little wider than the posterior flattened space.

I have collected the same species on the west side of the St. Croix river, about two miles below the Falls.

GENUS ARIONELLUS (BARRANDE).

ARIONELLUS BIPUNCTATUS.

PLATE II. FIGS. 50 & 51.

Arionellus bipunctatus: SHUMARD, Trans. Acad. Sciences of St. Louis, Vol. ii, No. 1, p. 101.

The following is Dr. SHUMARD'S description of this species:

"SMALL, moderately elevated. Glabella convex, conical, "truncated or sometimes very gently arched at apex: "length, excluding the neck-segment, equal to the "width at the base; sides gently convex; neck-furrow "straight, moderately deep and well defined; neck- "segment short, semielliptical, with the sides gently "rounded. Dorsal furrows distinct all around, as "deeply impressed as the neck-furrow, and marked "opposite each angle of the glabella in front with a "minute circular depression. No lateral furrows visible "on any of the specimens under examination. Front "margin rounded, and occupying about one-fourth the "total length of the head.

"MOVABLE cheeks regularly convex, margined with a nar- "row rounded raised border; genal angles prolonged "into long slender curved spines.

"LENGTH of head, 0·22 of an inch; length of glabella, "0·16; greatest width, 0·11. The general contour of "the head of this species, when deprived of the mova- "ble cheeks, reminds one of the head of *Homolonotus* "*delphinocephalus.*"

Through the kindness of Dr. SHUMARD, I have received specimens of this pretty little species. In the form of the glabella, it resembles some of the smaller species of CONOCEPHALITES; but the direction of the facial suture, and the form of the palpebral lobe, are distinguished features. At the same time, the form of the associated movable cheeks is not unlike many of those which occur with, and are referred to the smaller species of CONOCEPHALITES, while the fragments of thoracic segments are likewise of similar character.

The minute depressions, or puncta, at the anterior angles of the glabella, are well preserved in many specimens, while the occipital ring often bears a small obtuse spur. The minute pits in front of the glabella are well marked; but these are not peculiar to this species.

I follow Dr. SHUMARD in placing this species under ARIONELLUS, though it appears to me distinct from that genus, and not generically different from some of the preceding species.

From the associated fossils, I infer that this species occurs about the middle of the sandstone, "near the mouth of Lawrence creek, a small tributary of the St. Croix river, Minnesota; and from the mouth of Root river in Minnesota, in the same horizon.

In his Report on Wisconsin, Iowa and Minnesota, Dr. OWEN has described (on pp. 374 & 375) the *Dikelocephalus miniscaensis* and *D. granulosus.* From specimens collected at the same localities, I have recognized these species so distinctly as to leave no doubt of their identity. While possessing some characters of glabella in common with typical species of DIKELOCEPHALUS, there are other features which appear to me quite incompatible with that genus. The fixed cheeks are wider, and the facial suture has a different direction, while the movable cheeks are equally

distinctive in their form and in their posterior extension. The surface-marking in both species, but particularly in *D. granulosus*, is very peculiar, and unlike anything known in typical species of DIKELOCEPHALUS. I have found it necessary, therefore, to separate them from the latter genus. At the same time there is equal difficulty in referring them to any established genus, so far as I have access to published scientific works. I therefore suggest a distinct generic term that may include these two species, which, from present knowledge, I regard as similar generic forms.

GENUS PTYCHASPIS (n. g.).

[Gr. πτυχη, *plicatura*; ασπις, *scutum*.]

HEAD broad and strong, with wide depressed-convex cheeks. Glabella cylindrical, convex, deeply lobed or transversely furrowed, very prominent in front. Eyes anterior to the middle. The facial suture cutting the anterior border at a point between the eye and the glabella, or almost in front of the eye; and from below the eye it proceeds obliquely and in a slightly curving line to the base, at a point near to, or a little without the centre of the cheek, leaving the movable cheek of nearly the same dimensions as the fixed cheek. Movable cheeks subtrapezoidal, with a strong thickened border, which is extended into a spine. Eyes unknown. Palpebral lobe in one species, small.

The general direction of the facial suture is similar to that of ARIONELLUS; but the eye is more anterior, though of the same form. The strongly lobed cylindrical or subcylindrical glabella is a very distinctive feature. Thorax with strong articulations, the axis elevated, and the annulations marked by a broad node at their extremities: ribs marked by a subcentral groove, and

angularly bent backwards near the middle. Pygidium somewhat parabolic; the axis strong and elevated, marked by several annulations, and the lateral lobes by divided ribs.

The surface of the front of the glabella, the fixed and movable cheeks, in one species, are strongly and peculiarly lamellose-striate; and in the other known species, the cheek-borders are grooved, with angular striæ or ridges between them.

The imperfection of the specimens is such that the generic description must remain incomplete, until more satisfactory material can be obtained.

PTYCHASPIS MINISCAENSIS.

PLATE I, FIGS. 41–46; AND PLATE V, FIGS. 21 & 22.

Dikelocephalus miniscaensis: Owen, Geological Report Wisconsin, Iowa and Minnesota, page 574, Tab. 1, f. 3 & 12; and Tab. 1 A, f. 4 & 5.

Head large and strong, with broad cheeks having a thickened and striated border, which is produced in a short triangular spine behind.

Glabella large and strong, very convex, somewhat semi-cylindrical, about three-fourths as wide as long, the width at the anterior end about one-fifth less than the width at its base, rounded or subtruncate anteriorly, marked by two pairs of furrows; the posterior pair extending obliquely and deeply about one-third across the glabella, and connected by a straight transverse furrow. The second pair of furrows are shallow, oblique, and in older specimens can be traced about one-third across the glabella. In older specimens the anterior lobe occupies about one-half the length of the glabella, while in younger ones it is scarcely more than one-third the length. The occipital furrow is strongly defined; the occipital ring strong and prominent, and of nearly equal

width throughout. Dorsal furrow strongly defined, and continued in front of the glabella.

Fixed cheeks comparatively wide.

Facial suture vertical from the contour line in front to the inside of the palpebral lobe; thence turning a little outwards, it comes to the posterior margin halfway between the dorsal furrow and the outer margin of the movable cheek. The frontal limb is somewhat abruptly convex from the furrow, but never rises nearly so high as the frontal lobe of the glabella, and is abruptly bent downwards to the anterior margin. Eyes unknown.

Movable cheek large, somewhat trapezoidal: the outer limb is extremely thickened, with a few coarse longitudinal striæ preserved in the cast, extended behind, and uniting with the thickened posterior border, it forms a spine three-fourths as long as the body of the cheek. Within the thickened border there is a distinct groove, which is not quite united with the groove of the posterior limb.

Thorax strong; axis elevated, and the extremities of the annulations swelling into nodes: ribs strong, grooved in the middle, and bent somewhat angularly backwards in the middle. The anterior facette is abruptly turned inward.

Associated with the glabellæ and cheeks, there are several pygidia which appear to belong to the same species. The specimen fig. 46 is somewhat paraboloid, the axis strong and rounded, and marked by about four very convex rings: the dorsal furrow is deeply impressed by the lateral lobes rising abruptly, and becoming quite convex in the middle, and thence curving downwards to a narrow flattened border; marked by three ribs and an obscure fourth one, which are grooved from near their origin to the flattened limb.

This species is common, and even abundant in some beds of greenish gray sandstone at Trempaleau, and near the mouth of the

Miniska river. It is chiefly associated with *Ptychaspis* (*Dikelocephalus*) *granulosus* of OWEN.

This is unquestionably identical with the glabella figured by Dr. OWEN, Loc. cit., Tab. 1, f. 3 *a* & 12; and Tab. 1 A, f. 5. The pygidium (Tab. 1, f. 3 *b*) likewise corresponds with that figured Plate i, f. 46; the former being a somewhat larger individual.

The glabella of the young of this species bears some resemblance to the glabella of the more convex forms of *Dikelocephalus pepinensis;* but the posterior furrow is more oblique, and the second furrow more conspicuous, while the contour in front is more curved. It likewise resembles, in some of its phases, the *D. spiniger;* but the frontal limb of this is nearly straight, and the glabella is more truncate, while the glabellar furrows very nearly correspond. The form of the fixed cheek, however, distinguishes it at once from either of these, as well as from others of that genus. In young specimens, the glabella resembles very closely that of *Ptychaspis* (*Dikelocephalus*) *granulosus* of OWEN; but the second glabellar furrow in that species is continued across the glabella, and the posterior lobes are marked by a small tubercle at their extremities, while the front contour is distinctive.

Although referred by Dr. OWEN to the Genus DIKELOCEPHALUS, this species differs in having the sides of the glabella not parallel throughout, but more particularly in the form of the fixed cheeks, in the movable cheeks, and in the character of the palpebral lobes.

PTYCHASPIS GRANULOSA.

PLATE I. FIGS. 33–40.

Dikelocephalus granulosus: OWEN, Loc. cit., page 675, Tab. 1, f. 7 (and 5?).

HEAD broad, with a narrow frontal border and wide cheeks.

GLABELLA narrow, prominent, semicylindrical, of nearly equal width throughout, or sometimes a little wider in front than in the middle; marked by two strong transverse furrows which reach entirely across: the posterior one is a little oblique at the extremities, and straight in the middle; the second one is direct, or scarcely curving. The posterior lobe is wider, slightly bent forward, and subnodose at its extremities; while the extremities of the

second annulation are slightly curved forward, but not expanded. At the extremities of the posterior annulation, and separated from it by an indentation, there is on each side a small node lying nearly in the line of the dorsal furrow.

Occipital furrow strongly marked, straight in the middle, slightly curving forward at the extremities, and continued in the fixed cheeks: occipital ring narrow, prominent, and rising above the convexity of the glabella. Dorsal furrow strongly defined, slightly interrupted behind by the little nodes before mentioned. The frontal limb is depressed, a little convex in front of the furrow, and bent abruptly downwards.

The fixed cheeks rise abruptly from the frontal limb, to a prominence continued from the palpebral lobe to the dorsal furrow: the principal part of the area from the eye backwards being depressed convex, and produced into an angular termination at the extremity of the posterior limb. Surface strongly striate.

The surface characters are rarely seen in the casts; but in the impressions in the sandstone, they may be detected. The peculiar form of the glabella and fixed cheeks, the anterior position of the eyes, and strongly furrowed glabella with prominent rounded anterior lobe, are characters which readily distinguish this species from any other, except the young of *Ptychaspis* (*D.*) *miniscaensis*.

Dr. Owen has given the following

"*Specific character.* This species is distinguished particu-
"larly by the glabella and cheek-plates, as far as they
"are preserved, being studded with minute granules.
"The glabella is divided by three furrows into four seg-
"ments: the posterior segment terminates on either side
"in two obscure basal tubercles."

Strictly this description does not apply to the specimens; but I suppose the occipital furrow to be one of the three furrows mentioned, while the "posterior segment" terminating "in two obscure basal tubercles" can apply to the slightly tuberculated extremities, and

the small tubercles at the extremities of the posterior lobes of the glabella.

FIG. 33, is from a cast taken in a mould of the exterior surface, showing the striations; but the eye-lobes are not visible (figure enlarged).

FIG. 34, is from a cast of the interior in sandstone.

FIG. 35, a profile of the same.

FIG. 36. An enlarged figure from a small head of this species.

FIG. 37. A cheek of this species.

FIG. 38. Profile or lateral view of the same.

FIG. 39. A part of a thoracic segment.

FIG. 40. A pygidium found associated with this species, the form of which corresponds to the one figured by Dr. OWEN, Tab. 1, f. 5.

This species occurs in the greenish gray beds of Trempaleau and Miniska, in the central portion of the series, associated with *Ptychaspis miniscaensis*; and in gray beds a little lower in the series, associated with *Agnostus josepha*, *Conocephalites wisconsensis* and *C. anatinus*.

PTYCHASPIS (sp.?).

PLATE I. FIG. 48.

The figure (Plate i, fig. 48) is about three times enlarged, from small specimen which possesses the characteristics of this genus.

It appears to be an entire head, but no facial suture or eye-tubercle can be distinguished. It is possible that it may be the very young of *P. miniscaensis*, which, in all the smaller specimens, approaches the *P. granulosa* in its appearance. With a single specimen, I hesitate to characterize it as a distinct species.

It occurs in the sandstone at Trempaleau, associated with *P. granulosa* and *Agnostus josepha*.

GENUS CHARIOCEPHALUS (n. g.).

[Gr. χαρις, *gratia*; κεφαλη, *caput*.]

HEAD broad; cheeks moderately convex towards the eyes; glabella regularly convex, and marked by transverse furrows; eyes large; facial suture cutting the contour of the front at or near the centre. Thorax unknown. Pygidium?

CHARIOCEPHALUS WHITFIELDI (n. s.).

PLATE I, FIGS. 49–53; AND PLATE V, FIG. 20.

Head wide, with gently convex cheeks.

Glabella regularly convex, the sides rising rather abruptly from the depression, semielliptical, rarely appearing a little truncate in the front, and in the cast of the interior entirely smooth, or faintly marked by two pairs of furrows, the posterior one of which has rarely been seen to extend across the middle. Occipital furrow shallow, gently depressed: occipital ring depressed-convex. Dorsal furrow rather broad and well defined, continued in front of the glabella in nearly the same strength as at the sides; and just within the contour of the front, it is marked by two minute rounded pits.

The facial suture cuts the contour of the head at or near the middle of the front, and, making a gentle convex curve, it approaches the glabella just anterior to the eye-lobe, and following the curve of the latter to its posterior limit, continues in a gently diverging line to the base of the cheek halfway between the dorsal furrow and the outer margin.

Fixed cheeks narrow, suddenly contracted in front of the eye, and gently expanded towards the palpebral lobe, and extended in a comparatively short posterior limb. The frontal limb is narrow, convex, sublunate or sometimes sublinear and straight.

Movable cheeks with a regular circular curve from the front to the beginning of the spine at the posterior angle: the lower part of the cheek is wide, gradually narrowing anteriorly, with the border reaching to the centre of the front of the head. The inner angle shows a large ocular sinus. The posterior limb is extended into a straight diverging spine. The surface is gently convex towards the eye, gradually depressed to a broad

shallow groove, which leaves a thickened border of the same width.

This species is not uncommon in the friable greenish gray sandstone at Trempaleau, and in some associated magnesian beds. It is readily distinguished from all the other species by its narrow frontal border, and the contraction just anterior to the eye. The movable cheek differs from the others in the circular curving of its outer limb.

In its facial suture it approaches the Genus ARIONELLUS, and some separated thoracic segments in the same association are similar to those of that genus. The character of the palpebral lobe, with the large eye and form of cheek, are distinctive.

GENUS ILLÆNURUS (n. g.).

BODY robust, broadly elliptical: head short, convex, semielliptical, the front and sides regularly rounded and nearly straight behind.

GLABELLA subquadrate, convex, smooth, without distinct dorsal furrow: palpebral lobe marginal. Cheeks wide.

FACIAL suture nearly vertical, slightly diverging anterior to the eye.

MOVABLE cheeks wide and short.

THORACIC articulations moderately convex, with a wide central and narrow lateral lobe. Pygidium short, narrow, subelliptical, convex in front and more curved behind.

The similarity of this fossil to ILLÆNUS is manifest in all its parts; but the quadrate form and narrowness of the central part of the head, and the great lateral extent of the cheeks, offer some differences, which, regarding its primordial associations, I have thought it worth while to consider. The name proposed sufficiently indicates its relations with ILLÆNUS.

ILLÆNURUS QUADRATUS (n. s.).

PLATE II. FIGS. 52–57.

HEAD broad, semielliptical. Glabella convex, a little longer than wide, without visible occipital or dorsal furrow; a scarcely perceptible groove along the posterior margin; the width a little greater behind than before; sides concave; palpebral lobes marginal, a little behind the middle of the glabella.

FACIAL suture cutting the contour of the front a little within, or nearly in, a vertical line drawn through the eye, and making a very gentle concave curve to the outer margin of the palpebral lobe.

MOVABLE cheeks scarcely longer than wide, with a deep sinus below the middle, marking the form of the eye: posterior extremities rounded, and straight upon the posterior margin.

THE middle lobe of the thorax is wide and moderately convex; the lateral lobes narrow, little convex, and the extremities slightly bent backwards, and posteriorly acute. A narrow shallow furrow runs through the middle of the length of the segment.

PYGIDIUM short, convex in front and marked near its margin by a narrow groove, rounded behind.

The specimens observed are the casts of dismembered portions of the body; and occuring in sandstone, it is difficult to determine all the characters. The glabella, pygidia and cheeks are preserved in considerable numbers in a fragment of sandstone from near Osceola mills on the St. Croix river, from a position near the middle of the formation.

In more extensive collections made at other localities, no fragment of this species has been observed; and it is, therefore, with probability, inferred that its horizontal range is restricted.

GENUS TRIARTHRUS?

SUBGENUS TRIARTHRELLA (n. s.).

TRIARTHRELLA AURORALIS (n. s).

PLATE IV. FIG. 13.

A small and obscure species occurs among the DIKELOCEPHALI at Lagrange mountain, which has an elongate semioval glabella, with the fixed cheeks wide and spreading in the posterior limb, and very narrow in front. The glabella shows an obscure indentation at its margin (not so strongly as represented in the figure), and the general expression is like TRIARTHRUS.

The species can hardly be characterized from the imperfect specimens known, some four or five of which have been observed.

FIG. 13. The glabella and fixed cheeks. The figure is twice the natural size of the specimen.

*** For notice of a species of CONOCEPHALITES belonging to the first group of species indicated in this paper, see Explanations of Plate II.

GENUS AGNOSTUS (BRONGNIART).

AGNOSTUS JOSEPHA (n. s.).

PLATE I. FIGS. 54 & 55.

"*Agnostus orion* (?) BILLINGS": SHUMARD in Transactions Acad. St. Louis, Vol. ii, p. 105.

Not *Battus* [*Agnostus*] *orion* of BARRANDE, Notice preliminaire, p. 16, 1846 = *Diplorrhina orion*, CORDA, 1847.

HEAD semielliptical, a little wider than long; the sides usually curving, sometimes straight for a part of their length, margined by a flattened or concave narrow limb; rather abruptly convex at the sides: the posterior margin, just within the angles, is produced on each side into a short spine.

Glabella prominent, narrow, extending about two-thirds the length of the head, and crossed by a shallow furrow near its anterior end: the posterior lobe is marked by an oblique furrow on each side, and a small node on the summit at the anterior termination. The triangular space on each side, between the tranverse and oblique furrows, is likewise elevated into a low node. The posterior central portion is gibbous, narrowed at the base, with a small tubercle on each side. A narrow longitudinal furrow extends from the apex of the glabella to the marginal limb.

Pygidium of the same form as the head, or a little wider; axis prominent, subquadrangular, wider than long, nearly one-third the length of the pygidium, bearing a node or short spine on its posterior extremity; sides and body of the pygidium (outside of the axis) highly convex.

In some of the specimens, the sides are a little more straight and parallel than those given in the figures; and in several specimens, a truncation or slight emargination has been observed in the anterior border.

Fig. 54. The head of this species, three times enlarged.

Fig. 55. The pygidium of the same, enlarged in the same proportions as the preceding.

This species is common in some layers of gray sandstone, associated with *Conocephalites wisconsensis* and *Ptychaspis granulosa*, at Trempaleau. It occurs also at the mouth of Black river, and elsewhere on the Mississippi about Lake Pepin.

AGNOSTUS PARILIS (n. s.).

PLATE V. FIGS. 23 & 24.

The two extremities of similar form. The head semi-elliptical; length and width about equal, very convex in the posterior part, and curving downwards to the anterior margin.

The central portion of the posterior part is limited by a faint curving groove; and anterior to its limit there is a slight elevation, which may have been a node on the surface of the crust. The posterior margin, just within the angles, is produced in a minute node. The marginal rim gradually expands from the posterior angles to the front, where it becomes well defined.

The pygidium is of the same form as the head, slightly truncate at the anterior angles, and the marginal rim narrower towards the articulating border: the central part is slightly more elevated, and limited by furrows diverging from the anterior margin.

In the median line, at a point one-third the length from the anterior margin, there is a distinct elongate node.

Fig. 23. The head, about three times enlarged.
Fig. 24. The pygidium, enlarged in the same degree.

This species occurs in a yellowish or light drab-colored sandstone, on the shores of Lake Pepin. It is a well-marked species, and readily distinguished from the others by the shallow grooves on both parts, and the distinct node upon the pygidium.

In the part which I have termed the head, there is some appearance of an elongate glabella in front of the curving groove, but the indications are too faint to be satisfactory.

This species, and the *Agnostus disparilis*, occur in beds near the middle of the formation; while *A. josepha* occurs in beds which are apparently somewhat lower in the series, but the precise relations have not been determined.

AGNOSTUS DISPARILIS (n. s.).

PLATE V. FIGS. 25, 26 & 27.

Head semielliptical, convex towards the posterior side and abruptly sloping to the front; length and breadth nearly as three to four; a little concave on the posterior or articulating margin, and marked near the edge by a narrow groove on each side of the middle, the centre a

little elevated close to the margin. The marginal rim is a little wider in front than at the sides.

The specimens are casts of the interior in friable sandstone; and the finer markings, and even any marks of furrows, unless well defined, would not be preserved.

A pygidium? in the same specimen of sandstone is trilobate, a little wider than long. The trilobation extends nearly to the posterior extremity, and is separated from it only by a narrow border. The middle lobe is fully once and a half as wide as the lateral lobe, somewhat flattened on the summit, and very distinctly limited by the dorsal furrows.

In one specimen, the axis appears to be annulated; but in specimens so minute, when the accession or removal of a grain of sand may alter the form and characters of a fossil, it is not easy to decide in regard to the minor features of a species.

It is with some hesitation that I refer the separated parts to the same species; nor can it be decided positively that the trilobate form is the pygidium. The extension of the middle lobe so near to the extremity, offers an objection to regarding it as the glabella.

This species occurs in friable sandstone, with *Dikelocephalus osceola*, at Osceola mills on the St. Croix river.

Fig. 25. The head?, four times enlarged.

Fig. 26. The pygidium? enlarged in the same proportion.

Fig. 27. A specimen enlarged to the same degree; the middle lobe apparently marked by transverse furrows.

The few specimens of a dark rusty-colored sandstone from Osceola mills have proved very prolific of species. Besides those already enumerated, there are, in the same sandstone specimens, undeterminable fragments of other Trilobites; and among them are impressions of parts of the head, which is strongly pustulose, and portions of a pygidium of a very different character from any that have hitherto been noticed. Some fragments of the thoracic segments in the same stone are much larger than any corresponding parts of *Dikelocephalus minnesotensis* which have been seen in the collections, and perhaps belong to a species of that genus.

Whenever this locality, and the region about it, shall be more fully investigated, we may confidently predict that additions of much value and interest will be made to the primordial fauna of he Upper Mississippi valley.

GENUS AGLASPIS (n. g.).

THE investigations in the upper part of the Lower sandstone of the Mississippi valley have furnished me with the carapace, some fragments of the thoracic articulations, and what appears to be a caudal spine of a new and remarkable crustacean, for which I have proposed the name AGLASPIS.[1]

Generic description. CARAPACE wide, sublunate, or approaching semicircular; its superior crust not separable into parts by suture lines; a sinus in the middle of the front, and preserving some evidence of trilobation in the posterior part. Eyes anterior to the middle, large and prominent.

THORAX probably subtrilobate, composed of several articulations, which are recurved at their extremities. Posterior or caudal portion more elevated in the middle and strongly arching: the caudal extremity probably furnished with an elongate spine. Texture punctate

The only species known, in its carapace reminds one of LIMULUS; and though the resemblance is not so apparent in the character of the eyes, yet we find that these organs occupy the relative position of the two oculiform spots on the anterior part of the carapace of that animal. The segments of the abdomen, which in that genus are anchylosed, are here free, in their anterior members at least; while the posterior ones are highly arched and closely united. The associated spines, of the same texture as the other parts, can scarcely have had any other relation to the body than the caudle spine of LIMULUS; and the AGLASPIS, with its broad depressed-convex carapace and its anterior eyes, was furnished with a long caudal spine as in the modern genus.

[1] See Canadian Naturalist and Geologist, Vol. vii, p. 443, December 1862.

AGLASPIS BARRANDI (n. s.).

PLATE VI. FIGS. 7–16.

Carapace sublunate or semicircular, the diameter at base being more than twice the length; sides moderately convex; the middle more elevated, and showing indications of a trilobate character: front emarginate, or with a distinct sinus; the margin in front and sides limited by an elevated and thickened border, which is slightly extended at the posterior angles. Eyes large, broad-oval, very prominent, situated near together, and anterior to the centre of the carapace. Near the posterior margin of the central division, there are two small pustules.

Several fragments of thoracic articulations have been obtained: these are all recurved, in greater or less degree, at the extremities, without furrows upon the surface. A single segment remains apparently entire: it is highly arched, having an elevation nearly as great as the distance of the extremities. This segment is probably from the posterior part of the body.

A single spine, three inches in length, and a fragment of another similar one have been obtained. The texture is everywhere minutely punctate, and the surface minutely pustulose.

Fig. 7, is the largest carapace obtained: one side is imperfect, and the opposite angle broken off. The outline on the left is carried out from other specimens, where that part is entire.

Fig. 8, is a smaller carapace, not entire in front; and the centre of the anterior margin is covered by a bit of crust from some other part, or some other individual. This specimen shows the pustules on the posterior margin of the carapace.

Fig. 9, is the inner side of a portion of a small carapace, showing the cavities of the eyes.

Fig. 10. An enlargement of the surface, showing the texture.

Fig. 11. A segment of the body? probably from the posterior part of the animal.

Figs. 12, 13 & 14. Parts of segments? showing the characters of the extremities.

Fig. 15. A portion of a caudal spine of this animal.
Fig. 16. Another specimen of the same appendage.

These remains occur in the upper portions of the sandstone; and thus far the specimens have been derived from two localities, one near Miniska in Minnesota, and the other near Mazomania in Wisconsin.

This new and remarkable Crustacean is of great interest, since I believe no well-authenticated forms of this class, other than Trilobites, have been found so low in the series of formations. This fossil, moreover, if its relations be such as I have supposed, is of great interest considered in connexion with the Tracks in the Potsdam sandstone, which occur both in Canada and Wisconsin. Whether any relation may exist between the two, remains yet to be proved by farther discoveries of specimens, and also of the locomotive appendages which we may infer that this animal possessed, in character not entirely dissimilar to those of Limulus.

CONCLUSION.

Although I have not been able to recognize the successive Trilobite beds of the Sandstone as indicated by Dr. Owen, I can nevertheless refer the species here described to three different epochs in the Potsdam period; and I am not prepared at the present time to suggest any farther subdivision. In the lower beds of the formation I have found Conocephalites proper, together with Lingula, Lingulepis, Obolella? and Theca. In the middle stage, neither the limits of the beds, nor the range of species or genera, have been so well determined; but grouping together all that I have found between the well-defined upper beds and the lower fossiliferous beds known, we have Conocephalites, Dikelocephalus, Arionellus, Ptychaspis, Chariocephalus, Illænurus and Agnostus, in the trilobitic fauna, together with Orthis and Platyceras. The Graptolitidæ appa-

rently begin their existence somewhere in this central epoch, but their precise relations to the other beds have not been determined. In the higher beds of the formation, and clearly separated from the great central mass, we have the Genera DIKELOCEPHALUS, TRIARTHELLA and AGLASPIS, together with LINGULA, SERPULITES and EUOMPHALUS. We observe, therefore, that the earliest trilobites are referable to the Genus CONOCEPHALITES; and the Genus DIKELOCEPHALUS does not appear in the first stages of the formation, nor below the beds which I have referred to the second or middle stage of the period. There this genus appears in three species, smaller and less conspicuous than those in the higher beds. It is only in the later stages of the sandstone, that the typical species of this genus of Dr. OWEN appear; and those from the lower beds, thus referred by him, belong apparently to other genera.

There is much yet to be done in the middle and lower beds of the formation, both in the way of determining the range of species and genera, and in the study of new or imperfectly known species. I believe, however, that the specific and generic relations here indicated may serve to guide investigation; and as the localities are often isolated, the position in the series may be determined by a little attention to these remarks, and a comparison of the characters of species and genera.

Comparatively few species have been determined from authentic Potsdam sandstone in its more eastern localities, although numerous forms have been described from calcareous and shaly beds, regarded by some geologists as equivalent, by others as newer, and by still others as older than the Potsdam sandstone. I have made no comparisons with these, since they appear to me all entirely distinct from those which I have enumerated and described from the sandstone of the Mississippi valley, and approached in character only by the later forms of that period.

In this connexion, moreover, our attention is directed to

the fact that this sandstone of the Mississippi valley, in its eastern extension, has greatly thinned towards the outlet of Lake Superior; and from observations on the Escanaba and Menomonee rivers, I am satisfied that its thickness is greatly reduced, there being but a narrow space between the Lower Silurian limestones and the crystalline rocks. These crystalline rocks of the south shore of Lake Superior had assumed essentially their present condition before the deposition of the Potsdam sandstone; the ocean on the west of this barrier was, in a measure, separated from that on the east; and the distribution of the fauna has probably been influenced by the same causes.

Notwithstanding the successive stages recognized, the physical conditions have been very monotonous throughout the entire period; and in the character of the fauna, there are similar indications. We find great numbers of individuals of one species; and although recognizing very distinctly numerous species, there is a kind of uniformity of character and monotony of expression, never equalled by so many species in any formation of equal thickness, or even of much less thickness, where consisting of varied character and conditions of deposit.

The multitude of individuals of a few species is really wonderful; for in some beds the layers may be separated at every inch, or even half-inch, and yet the entire surface is covered with the dismembered parts of these ancient trilobites.

In the preparation of this paper, I have received much valuable assistance from Mr. R. P. Whitfield, whose discrimination in distinguishing the fragmentary species, and mechanical skill in disentangling these fragile materials from a friable sandstone, as well as accurately representing them in the illustrations, have enabled me to describe and characterize species which otherwise would, at the present time, have been left untouched.

SUPPLEMENTARY NOTE ON THE POTSDAM SANDSTONE.

When I commenced this paper, I had intended to confine myself strictly to the description of fossils in my collection from the sandstone of the Upper Mississippi valley, and a comparison with those previously described from that region of country.

I have not desired to depart from this course; and I have already said that it formed no part of my plan to compare these western forms with those of more eastern localities, which have been obtained in the older rocks of Canada and Vermont, and brought out in the publications of the Canadian Survey. I cannot, of course, have failed to perceive a similarity of form between some of the Western Trilobites, and those from the Quebec group; though I believe there is not specific identity in any of them. Should such identity be proved hereafter, the latter would of course have prior authority in the nomenclature. There has been no opportunity for a comparison of the fossils of these two regions; and those of both being in a fragmentary condition, it may ultimately turn out that the discovery of more perfect individuals may establish relations which are not at present apparent. I am authorized to say, however, that Sir William E. Logan is still disposed to regard some of the trilobites of the Quebec group as occuring in masses which may have been derived from a somewhat older formation, and imbedded in these strata at the time of their deposition.[1]

In making a comparison between fossils of the Quebec group, as developed in Newfoundland, on the one hand, and in several localities in Eastern Canada on the other, it is remarked that while there is a general resemblance

[1] Geology of Canada, 1863, p. 860.

between the faunas of the two extremes, "the Newfoundland rocks have none of the Trilobites, such as CONOCEPHALITES, DIKELOCEPHALUS, MENOCEPHALUS, and others which give to a small portion of the Point-Levis series a primordial aspect."[1]

The western species are all from sandstone of well authenticated position and relations with the superincumbent rocks, but of moderate thickness as compared with the Potsdam and Quebec groups of Canada, Vermont and Newfoundland; and we do not yet know the character and fossils of the lowest beds of the formation. It seems to me, therefore, that the comparisons can be more satsifactorily made after we shall have become more fully acquainted with the Quebec and Potsdam species and their stratigraphical relations. If there are any points yet in doubt among these disturbed strata, which can be solved by palæontological facts, these few species from the West may perhaps offer some aid in the solution.

I learn from Sir WILLIAM E. LOGAN that an important part of these ancient strata in Newfoundland, of the age of the Quebec group, are comparatively undisturbed and highly fossiliferous. Whenever the fossils from these undisturbed strata shall have been studied, together with those from the nearly horizontal sandstones of the Mississippi valley, there will be afforded adequate means of making a comparison with the fauna of the disturbed portions of the intermediate country; and thus doubtless some questions, at present undetermined, will find a solution.

In comparing the older rocks of New York and of the East generally, with those of the West, it should not be forgotten that there is a long interval on the line of the northern outcrop of these ancient strata, between the St. Lawrence and the western limit of Michigan on the Menomonee river, where we can expect little aid from palæontology. The fossiliferous beds of these ancient

[1] Geology of Canada, p. 263.

formations in Wisconsin lie to the west of what appears to have been a great promontory at the time of their deposition, stretching southward from the region of Lake Superior far into the ancient sea. The disconnexion caused by this promontory between the East and the West, would of itself prepare us to expect a fauna, differing, in a great degree, from beds of corresponding age on the opposite sides.

It has been shown, by the investigations of the Canadian Survey, that not only the Potsdam sandstone, but all the fossiliferous beds below the Birdseye and Black-river limestone are absent from Kingston on Lake Ontario to Lacloche on Lake Huron. From Lacloche to Lake Superior, there is a sandstone coming in below the Birdseye limestone, which from its position may be considered as of the age of the Chazy formation,[1] and equivalent to the St. Peters sandstone of Wisconsin and Minnesota; and it is this sandstone, doubtless, which has been taken for the Potsdam sandstone in some localities along that line.

The succeeding Birdseye and Black-river formation, from Lacloche to Lake Superior, has become a buff-colored magnesian limestone, or weathering externally to this color, but still holding the characteristic fossils.

In New York, a sandstone (the Potsdam) lies immediately beneath a magnesian limestone ("the Calciferous sandrock"): this deposit is succeeded by a calcareous formation (the Chazy), including a sandstone, and surmounted by the Birdseye, Black-river and Trenton limestones.

In Wisconsin, Iowa and Minnesota, we have undoubted Trenton limestone, and below it a buff-colored magnesian limestone containing so many of the characteristic fossils of the Birdseye and Black-river limestones as to leave no

[1] The "Chazy formation" of the Canadian Geological Survey, in its eastern localities, includes a sandstone which comes in below the greater part of the limestone, leaving from ten to twenty feet of shale and limestone beneath (*Geology of Canada*, 1863, p. 123). It is apparently this sandstone of the Chazy formation, having in Canada a thickness of fifty feet, which has become augmented in its western extension, while the calcareous part of the formation has partially or entirely disappeared.

doubt of the parallelism of these beds with those of New York. Below this magnesian limestone we have the St. Peters sandstone, corresponding, as already shown, with the Chazy formation; and beneath this a magnesian limestone, which, in its position and lithological character, corresponds in all respects with the "*Calciferous sandrock*" of New York.

It is from all these facts, that the lower sandstone of the Upper Mississippi valley has been placed in parallelism with the sandstone of New York known as the "Potsdam."

Notwithstanding however that this sequence is precisely like that observed in New York, it may not yet be regarded as proved that the sandstone, from which I have described these fossils, is in all respects the equivalent of the Potsdam sandstone of New York, Vermont and Canada. It may represent more, or it may represent less, than that formation. The *lower* accessible beds of the Mississippi valley may represent the Potsdam of one hundred and fifty or two hundred feet in thickness in the typical localities in New York, while the middle and upper beds of the West may be of epochs not represented in that part of the series studied in New York; and in some other places, as in the regions just mentioned, the same epochs may be represented by a shaly or semi-calcareous deposition, or may be included in the commencement of the Calciferous epoch. It should not therefore be regarded as decided that the Potsdam sandstone, as developed in New York, occupies the entire interval from the base of the oldest sedimentary formation of the palæzoic era, to the Calciferous sandstone. From what we know of the primordial fauna in other localities,[1] we are prepared to find beds above or below, or

[1] This formation, in Canada, has a thickness of between six and seven hundred feet (*Geology of Canada*, pp. 88 & 89); but even there it is not supposed to represent the entire primordial zone. Nor does the fauna, at

both above and below, the epoch represented (so far as now known) by the Potsdam sandstone of New York, and which may still be of the same period.

The evidence from the undisturbed region of the Mississippi valley shows that the period of the Potsdam sandstone, or a very considerable part of it, may be represented by a small proportion of arenaceous matter. The section of the rocks of Missouri, given by Prof. SWALLOW, shows four separate magnesian limestones[1] and three distinct sandstones, below beds which he recognizes as the Birdseye and Black-river limestones. Taking the upper of these magnesian limestones to represent the base of the Birdseye and Black-river limestones,[2] the upper "Saccha-

present known, bear so exclusively a primordial character as to lead us to suppose that we have reached the lowest beds. The typical forms of PARADOXIDES of Braintree, Massachusetts, and of Newfoundland, indicate, on palæontological grounds alone, a lower horizon than any we have reached in New York, Canada, or in the Mississippi valley.

I have already noticed, in the preceding pages, the relations of some of these Trilobites with PARADOXIDES in certain parts of their structure. The condensation of generic characters observed in true PARADOXIDES (as well as in typical CONOCEPHALITES and OLENUS) seem to be diffused among the generic forms of the sandstone of the Mississippi valley; on which account alone, I would infer that this fauna is of a later epoch than the oldest primordial fauna. I have made similar observations regarding those forms, sometimes termed PARADOXIDES, in the older slates of Vermont.

[1] The section given by Professor SWALLOW is as follows:

BLACK RIVER AND BIRDSEYE LIMESTONE.

Calciferous Sandrock.	FIRST MAGNESIAN LIMESTONE	190 feet.	Magnesian Limestone Series.
	SACCHAROIDAL SANDSTONE	125 "	
	SECOND MAGNESIAN LIMESTONE	230 "	
	SECOND SANDSTONE	70 "	
	THIRD MAGNESIAN LIMESTONE	350 "	
	THIRD SANDSTONE	20 "	
	FOURTH MAGNESIAN LIMESTONE	300 "	

[2] Dr. SHUMARD has remarked (Geological Report of Missouri, Part ii, p. 160), that the fossils of this higher Magnesian limestone "are most like

roidal sandstone" to represent the Chazy or St. Peters sandstone of the Upper Mississippi valley, we would then have in the Second Magnesian limestone a representative of the Calciferous sandstone, or lower Magnesian limestone of Wisconsin and Iowa, with a thickness of two hundred and thirty feet.[1] Below this, therefore, if the depositions were uniform, we should find the sandstone as seen on the Upper Mississippi; but instead of a continuous arenaceous formation, we have as follows:

Second sandstone.....	70	feet.[2]
Third Magnesian limestone...	350	"
Third sandstone.....	50	"
Fourth Magnesian limestone.	300	"

We look in vain, therefore, for that great development of arenaceous sediments at this period, which we find farther to the north in the Mississippi valley.[3]

Considering this great augmentation of magnesian limestone towards the south, and the largely increased thickness of the sandstone farther north, we might be prepared

those of the Rlack river and Trenton groups." There can be no doubt but here, as well as elsewhere in the West, this fossiliferous magnesian limestone is of the age of the Birdseye and Black-river limestone.

[1] Dr. Shumard, however, considers the Third Magnesian limestone as the equivalent of the "Calciferous sandstone" of New York and of the "Lower Magnesian limestone" of Iowa and Wisconsin. This opinion is founded on identical or similar forms of fossils; and admitting this evidence, it will necessarily modify the conclusions which have heretofore been drawn from the interpreted sequences.

[2] Dr. Shumard has given this sandstone as attaining a thickness of one hundred and twenty to one hundred and forty feet in some localities (*Geological Report of Missouri*, p. 166).

[3] If we take the First Magnesian limestone of Prof. Swallow as the representative or equivalent of the Eastern Calciferous sandstone, it will not materially alter the general conclusion; for we add but 125 feet of sandstone, with 190 feet of magnesian limestone, above the beds just cited.

to expect the final disappearance of the limestone in that direction, and of the sandstone to the southward. Now it happens that to the north of the localities on the Upper Mississippi valley, we have upon Lake Superior, a great development of sandstone, the precise age of which has for some time been debated, and from which no fossils have been obtained, with the exception of a single species of LINGULA[3].

In his Report for 1840, Dr. HOUGHTON says:

"This Lake Superior sandstone, in its easterly prolongation, rests "against and upon the primary range of the Ste. Marie's river, "before described; while on the south, it is seen to pass beneath "the limestone at the Nebeesh rapids of the boat and canoe chan- "nels of that river. The rapids or falls of the Ste. Marie's river "are formed by the passage of the waters over the outcropping edge "of the sandrock, which inclines or dips from this point southerly; "thus passing conformably below the limestone before alluded to."

So long since as 1845, I had myself observed that the sandstones of the St. Mary's river come out from beneath the Black river and Birdseye limestones; but the Calciferous sandstone was nowhere visible in the immediate neighborhood. The later and more complete investigations of the Canada Geological Survey have proved the absence of the Calciferous sandstone, and of the Potsdam sandstone, on the north shore of Lake Huron; and also that this sandstone of St. Mary's river (which is now regarded as identical with that of the south shore of Lake Superior) rises from beneath the Black river and Birdseye limestone, and there is no evidence of the Calciferous sandstone in that region. It is the opinion of SIR WILLIAM LOGAN that this sandstone represents the Upper sandstone, or fills the place of the Chazy formation in the East,

[1] This LINGULA I have formerly referred to *L. prima* of the Potsdam sandstone; but a later critical examination of the specimens which have been more carefully separated from the surrounding stone shows it to be more nearly related to a species in the Calciferous sandstone.

the limestone being absent; and that it is this arenaceous deposit greatly augmented, which gives the Sandstone formation of the south shore of Lake Superior.[1]

In 1846, Mr. C. C. Douglass discovered a fossiliferous magnesian limestone resting upon sandstone on the south side of Keweena point, in a line between the head of the Bay and the mouth of the Misery river. In 1848 or 1849, Messrs. J. W. Foster and J. D. Whitney brought from this locality several species of fossils, which were submitted to the examination of the writer. The geologists of Michigan represent that the same sandstone, at Grand island, is succeeded by a fossiliferous limestone, which is doubtless the same as that of Keweena point.

The characters of the fossils from the locality on Keweena point is such as to leave no doubt that the limestone is equivalent to the Buff limestone of Wisconsin; holding the identical fossils, and representing the Birdseye and Black-river limestones. The order of sequence in Central and Western Wisconsin, and in Iowa and Minnesota, is that already given, viz:

Buff limestone = Birdseye & Black-river;
St. Peters sandstone;
Lower Magnesian limestone.

Now the beds of Buff limestone at Keweena point rest upon a sandstone which has a much greater thickness than the St. Peters sandstone is known to have in any of its western localities; nor has the Lower Magnesian limestone been seen below that sandstone, so far as we know; unless the magnesian limestone seen by Mr. Murray, of the Canadian Survey, at the mouth of the Dead river,[2]

[1] Geology of Canada, 1863, pp. 83–86.

[2] On this [the south] coast at the mouth of the Dead river, north of Marquette, there is a mass of very ferruginous dolomite, of which the stratification is not very distinct; but it is overlaid by the sandstone, which

beneath the sandstone of the south shore of Lake Superior, be the true Lower Magnesian limestone or "Calciferous sandrock."

In assigning a position to the sandstone of the south shore of Lake Superior, to the south and east of Keweena point, from the evidence before us, and in the absence of any fossils which may aid the decision, we are forced to conclude that this formation is a greatly augmented development of the St. Peters sandstone; or, that the Lower Magnesian limestone ("Calciferous sandrock") has thinned out, so as to leave the St. Peters sandstone and the Potsdam below (as developed in the Mississippi valley) to go on as one mass to the northward.

This latter inference would be sustained, in some measure, by the facts observed in Missouri, where we have nearly nine hundred feet of the three Lower Magnesian limestones, which, in Southern, Central and Southwestern, Wisconsin, are represented by rarely more than two hundred or two hundred and fifty feet of similar rock. At anything like this ratio of thinning, the Lower Magnesian limestone would have disappeared long before reaching the parallel of the south shore of Lake Superior, or it might continue to occur in isolated lenticular masses.

It is scarcely possible to suppose that the lower sandstone of the Upper Mississippi valley has not, at some time or in some form, extended as far as Lake Superior; but it is far from being proved that the sandstone now so largely developed on the south shore is that sandstone, as we have

fills up the inequalities in the surface of the dolomite, and dips at a moderate angle to the southwest. The dolomite is cut by what appears to be a vertical dyke, which, instead of intersecting the sandstone, abuts against the bottom of it (See Geology of Canada, 1863, pp. 83 & 84).

In the Mississippi valley, the Upper sandstone is apparently conformable to the Magnesian limestone on which it reposes; but its lower beds sometimes consist of a fine argillaceous sediment, indicating a lapse of time before the arenaceous deposit began; while in other places, the superincumbent sand has penetrated into fissures in the rock below, and I have never observed any beds of passage between the two formations.

shown. If this sandstone consist of both that above and that below the Calciferous, or of the St. Peters and the Potsdam proper, then at some point we should expect to find a change of character, or nonconformity between the beds, to indicate the lapse of time in the deposition of the Lower Magnesian limestone of more southern localities; and this view is sustained by the observed want of conformity between the sandstone and Magnesian limestone near Dead river just cited.

Admitting the deposition of the lower sandstone of the Mississippi valley to have been continued in its higher stage into the region of Lake Superior, it seems remarkable that the rock now exposed along its shore should be so destitute of fossils; while we find equal difficulty in accounting for the sudden augmentation and difference of character of the St. Peters sandstone of Wisconsin, if we conclude the Lake Superior formations to be the same or equivalent beds. This difficulty, however, is not greater than we have in identifying the lower sandstone of the Mississippi valley with the thin formation in Missouri and elsewhere.

We have at Trempaleau and in the vicinity of Lake Pepin, together with what we find on the Black and Chippewa rivers, something like five (perhaps six) hundred feet of sandstone below the Lower Magnesian limestone; while in Missouri its only known representative in kind are the two beds of sandstone already noticed, alternating with massive formations of magnesian limestone, and together having a thickness of one hundred and twenty feet. The actual thickness of the sandstone in the northern localities cited is not known, but it is presumed to be much more than that which is exposed above the river-level: the entire thickness is probably not less than eight hundred feet, and perhaps much more. This mass therefore is apparently represented by one hundred and twenty feet of sandstone in Missouri; and this is divided into two bands, which may

represent two of the epochs noticed in the northern localities, as indicated by the fossils of the Upper Mississippi valley.

Regarding, for the present, the formations below the St. Peters or Saccharoidal sandstone in Missouri as equivalent in age with those of Wisconsin, we are compelled to recognize the Third and Fourth Magnesian limestones of the Missouri Reports (as well as the Second and Third sandstones) as represented in the sequence by the sandstone of the Upper Mississippi river.[1]

The material of this older sandstone has doubtless been derived from the crystalline quartzose rocks of the Huronian period, and which are still exposed in extensive masses on the southern side of Lake Superior, rising from beneath that formation.

Taking this view of its origin we are, in the region of the Upper Mississippi, not far from its source; and the older conglomerates at the base of the sandstone in the central part of Wisconsin, which are similar to some of those on the south shore of Lake Superior, may have marked the coast-line from which the materials of the formation were derived, while the finer sand was precipitated in the deeper ocean along the abruptly shelving coast to the southward.

In this sheltered position, accumulating to great thickness, while the gradual depression of the ocean-bed was going on, it has preserved, in all its stages, the phenomena of beach-lines, ripple and wave-lines, and even mud-cracks, with fucoidal remains in its lowest beds; affording at the same time favorable habitations for myriads of crustacean forms, and certain Mollusca which mark its successive stages. At the period when these shallow water or beach-lines are indicated in the sandstone of Lake Pepin and

[1] The fossils described from the Third Magnesian limestone by Dr. Shumard, do not, I believe, include any Trilobites; but all the species bear more analogy with those known in the Calciferous sandstone of New York and of Canada, and Dr. Shumard regards this rock as of the age of the lower magnesian limestone of Iowa, Wisconsin and Minnesota.

Trempaleau, the conditions farther to the south may have favored the accumulation of a magnesian limestone.[1]

The force of the oceanic current was apparently not sufficient to transport to great distances the arenaceous sediment; and to this cause is probably due its attenuation in Missouri, and its almost entire absence farther to the south.

The depression of the coast-line, whether a constant or a periodic movement, would be attended by a more or less marked change in the character of the sediments. At the time of the accumulation of the St. Peters or Chazy sandstone, not only was the Potsdam sandstone of the Upper Mississippi valley far beneath the sea-level, but, inferring from the undisturbed condition of adjacent portions of the country, the *source* of the materials of the older sandstone, the Huronian coast-line, had likewise become depressed beneath the level of the ocean. Consequently the source of this higher sandstone, still in part the coast-line of the Huronian rocks was removed farther to the north, and probably may have included to some extent the Laurentian formation.

Admitting this view of the case, we should expect to find the older conglomerates of Lake Superior overlaid unconformably by the sandstone of the newer period; while the conglomerates of the latter would be found still farther to the north, marking the outline of the ancient coast. We are met, however, with serious objections to this view; for the conglomerates of the north and east shores of Lake Superior are uptilted and cut by numerous trap dykes, while the sandstone of the south shore is nearly horizontal, and not penetrated by trap dykes, which some-

[1] There are at intervals in this sandstone, from near its base, thin bands which have an apparent magnesian character; so that even in the well-marked arenaceous portions of the formation, dolomitic despositions have occurred.

times cut the rock immediately beneath. The present aspect of the formations indicates a greater easterly extension of the upper sandstone than of the lower formation; while in a westerly direction, we know little of the higher sandstone beyond the eastern portions of Minnesota.[1]

Whether we may have, in the Lake Superior region, evidences of more than two periods in the accumulation of the conglomerates shales and sandstones, indicated by want of conformity one with the other, I am not prepared to assert from my own observations. I have already cited the opinion of Dr. HOUGHTON regarding the sandstone in its eastern extension toward the outlet of the lake, together with corroborative evidence from other sources, that this sandstone is of the age of the Chazy formation. In a later Report (1841), Dr. HOUGHTON recognizes a quadruple division of the sedimentary formations in the following order: 1st, "Conglomerate rock;" 2d, "Mixed conglomerate and sandrock;" 3d, "Red sandstone and shales;" and 4th, "Upper or Gray sandrock." Of the third division, he remarks, p. 40: "The red sandrock is less fre-
"quently traversed by dykes of trap than either of the
"rocks before described, though dykes were several times
"noticed traversing the whole of the several formations up
"to and including the Red sandstone." Of the fourth
"division, he says (p. 52): The composition of this rock
"differs from that of the lower sandrock, in being more
"exclusively quartzy; while in epoch of deposition, the
"rock under consideration should not be confounded with

[1] We know, however, from the explorations of Dr. HAYDEN, of the occurrence of the older sandstone towards the base of the Rocky Mountains (judging from the fossils); and we suppose that this may be connected with that of the Mississippi valley, and may have had a similar source. It is known that rocks of Huronian age extend westerly and northwesterly from the south side of Lake Superior, and these at one time must have furnished the materials for the deposits. Still, this would not make an objection, but rather sustain the argument I have advanced, so far as I have knowledge of the occurence of this rock.

"that of the Red sandstone. It has already been stated "that the Red sandstone of the south coast dips regularly "northerly, while the upper or Gray sandstone dips equally "regularly south or southeasterly; in which respect the "last mentioned rock conforms to the limestone resting "upon it, while it rests itself upon the uptilted edge of the "red sandrock below."

We have therefore an unequivocal assertion of the unconformability of the upper sandstone with the rocks below.[1]

Dr. OWEN, at a later period, in making investigations from the Mississippi valley to Lake Superior, has very clearly shown the probability, if not the ascertained certainty, that the Red sandstone of the western part of Lake Superior is inferior to the fossiliferous sandstones of the Upper Mississippi and St. Croix valleys; and he suggests that the latter may lie unconformably upon the disturbed and uptilted formation below.

From the disturbed and highly inclined position of the interstratified conglomerates and sandstones on the northern and eastern shores of Lake Superior, Sir WILLIAM LOGAN has become convinced that these deposits are older formations, and unconformable to the sandstone of the south shore from Keweena point to the eastward.

The testimony, therefore, of all those who have investigated the localities, concurs in recognizing two or more eras in the deposition of the conglomerates and sandstones of the Lake Superior region. And while the older beds of that area are apparently below the fossiliferous beds of the Upper Mississippi valley, the newer sandstone of the St. Mary's river, which is apparently of the age of the St. Peters sandstone, or the Chazy formation, will be found

[1] It would appear, however, that at a subsequent period, Dr. HOUGHTON was induced to regard the conglomerates and red sandstones and shales which are penetrated by trap rocks, to be of the New Red sandstone.

overlying the fossiliferous sandstone, either with or without the intervention of the Lower Magnesian limestone.

I have appended these few facts and arguments, with a view of presenting, in connextion with this notice, some of the points of interest yet remaining undetermined in regard to the older deposits of the West, and the difficulties in the way of determining their satisfactory parallelism with those of the East, considering simply the sequence of formations as originally presented in the State of New York.

ADDENDUM.

ON SOME FOSSILS OF THE LOWER BEDS OF THE POTSDAM SANDSTONE OF THE UPPER MISSISSIPPI VALLEY.

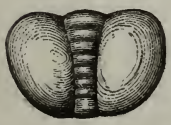
Since the completion of the printing and engraving of the plates relating to the fossils of the sandstone of the Upper Mississippi valley, a re-examination of some of the specimens from the lower beds near Trempaleau, by Mr. Whitfield, has brought to light several forms, quite new and distinct from any before noticed. One of them, a Crustacean somewhat resembling the pygidium of a Trilobite, has a very narrow axis and large swollen lateral lobes. It differs from the pygidium of a trilobite, in the extension of the narrow axis quite to the margin of the shield. On the straight side, the articulating face (if such it be) differs essentially from the corresponding parts of a trilobite. In these respects, also, it differs from Agnostus.

From its remarkable characters, it seems necessary to designate it as an undescribed generic form; and I propose the name Pemphigaspis.

GENUS PEMPHIGASPIS (n. g.).

Generic characters. The general form of the part of the shield known is semielliptical, rounded behind, nearly straight in the middle in front, and becoming rounded towards the outer margin; distinctly trilobate. Axis narrow, straight, and slightly narrowing posteriorly; distinctly annulated: annulations direct. Lateral lobes ovate, extremely gibbous or ventricose, rising much above the axis: margins at the sides abruptly incurved.

PEMPHIGASPIS BULLATA (n.s.).



Three individuals of this species have been examined: the largest is about one-fifth of an inch in width, and a little less in length. The axis is marked by seven annulations, besides the posterior one: the lateral lobes are smooth, ovate, and very ventricose. The anterior extremity of the middle lobe, with a small area on the inner anterior face of the lateral lobes, may have been articulating faces. The lateral margins are abruptly incurved, flat below, with a narrow elevated ridge just without the inner edge.

The specimens are casts of the interior, and the character of the exterior surface is unknown. The figures are six times enlarged.

Fig. 1. The upper surface, Fig. 2. The lower surface.
Fig. 3. A profile view from the posterior extremity.

GENUS AMPHION?

A single glabella, much resembling in its lateral lobes the glabella of a Calymene, has been found in a specimen from the lower beds near Trempaleau.

Although not entirely corresponding with Amphion, I refer it, for the present, to that genus.

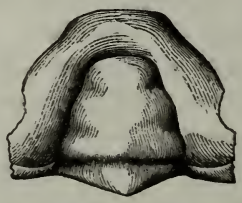
AMPHION? MATUTINA.

GLABELLA gibbous, longer than wide, subovate, rounded and a little wider in front. Occipital ring narrow and straight; occipital furrow narrow. Posterior lobe a little oblique, the furrow deeply impressed and a little expanded at its inner extremity: median lobe with the sides nearly parallel, separated from the anterior lobe by a narrow distinct furrow; anterior lobe broad, the length somewhat less than half the entire length of the glabella, a scarcely defined depression extending obliquely from near the middle of its length to the front.

A part of one of the fixed cheeks remaining is semielliptical, a little wider behind than in front.

The specimen is too imperfect to admit of tracing the facial suture.

CONOCEPHALITES? (ARIONELLUS?) DORSALIS (n. s.).



Several small specimens have been observed, preserving the glabella and fixed cheek.

GLABELLA moderately gibbous, minute, truncate-conical, a little wider at base than the length from the occipital furrow, with two distinct slightly oblique furrows, the posterior ones most oblique, and reaching about one-

third across the glabella; occipital furrow and wel noarwr defined; occipital ring wider, more prominent in the middle, and produced into a node (which in the crust has probably been a short spine). Dorsal furrow well defined, and continuing of the same width and strength in front. Fixed cheeks a little wider at base, prominent and continuing in a convex border in front.

The specimens have the form and aspect of *Arionellus bipunctatus;* but the glabella is more distinctly lobed, and the puncta at the anterior angles do not exist in this one.

CONOCEPHALITES OPTATUS (n. s.).

Specimens retaining the glabella and fixed cheeks have been observed.

GLABELLA narrow conical, and rounded anteriorly. The posterior lobe is small, oblique, and nearly separated from the glabella: the middle lobe is oblique, and longer than the posterior one; anterior lobe less distinct. Occipital furrow narrow and well defined: occipital ring rounded, prominent, and a little more elevated than the summit of the glabella.

The glabella slopes to a broad depression in the frontal limb, which is terminated by an abruptly elevated border. The posterior limb of the fixed cheek is much extended laterally; and the facial suture approaches the glabella near the front, where the fixed cheek preserves a little elevated ridge like a palpebral lobe.

This species is interesting in perserving the peculiar characteristics of the Genus CONOCEPHALITES, and also approaching the *C. sulzeri* of Europe.

Art. IV. *History of the Census in New York, and Plan proposed for the State Census of* 1865. By Franklin B. Hough.

[Read before the Albany Institute, Dec. 19, 1864, and before the American Geographical and Statistical Society, February 2, 1865.]

I invite your attention to a brief historical sketch of the several enumerations of the population that have been made in New York, and shall present as fully as practicable, some of the proposed modifications recommended for adoption in the state census which is required by the constitution to be taken during the present year.

I shall not undertake to present any of the results of previous enumerations of the population, but shall limit myself entirely to a consideration of the methods employed in obtaining the census, the scope of inquiries proposed, and such suggestions as a careful study of the subject, while directing the labors incident to the last state census, brought to my notice as desirable features to be incorporated in the next.

During the Dutch period of our Colonial history we have about half a dozen statements of the population, which are but little better than estimates.

The first attempt at a census during the English period was in 1686, when Gov. Dongan, with the advice of his council, and in pursuance of a request of the committee of trade, directed the sheriff in each county in the colony to report on or before the first day of April ensuing, the military strength, number of inhabitants and merchants, English or foreigners, — the number of servants and slaves in

each, together with the number of marriages, christenings and burials that had occurred within seven years. To these were added inquiries concerning quit rents, revenues, escheats, forfeitures, duties, &c., the names of patuntees under the crown and the rents due from each throughout the colony.

We thus observe, in the beginning, the natural and legitimate business of the census, as affording to the government the information needed for an intelligent administration of its affairs, and the adoption of a practice long afterwards continued, of assigning this duty to the sheriffs of counties. Indeed the practice with regard to the Federal census has been from the first, and now is, to cause the enumeration to be made by marshals of the district courts and their deputies. These officers possess functions analogous to those of sheriff, in attending to the execution of the laws, and their acknowledged authority might under some circumstances tend to a more prompt compliance with their demands.

In 1697 an enumeration of the inhabitants of the city and county of Albany was ordered for the purpose of ascertaining the losses that had occurred from the molestation of their enemies in Canada, and the result presents the earliest attempt at classification that our local history affords, but extended no further than the primitive subdivisions of "men," "women" and "children,"—and the numbers departed from the colony,—taken prisoners, killed or died from natural causes.

In 1698 a full census of the provinces was taken by the high sheriffs and justices of the peace by order of Governor Bellomont. The result presented one more class than the preceding, the whites being classified as men, women and children, and the negroes in the aggregate only.

In 1703 Lord Cornbury, as governor, issued an order to the sheriffs to enumerate the people in each county, dis-

tinguishing by age, sex and color. In tabulating the results, the males from 16 to 60, total number of females — number of male and female children, — number of male and female negroes, — number of male and female negro children, and total above 60 without reference to sex or color, were reported in separate columns.

This crude conception, with its slight utilitarian features, received a decided improvement in the next official census, taken by order of Governor Hunter in 1712, in compliance with a request of the lords of trade, for information concerning the affairs of the province. It was made by justices of peace, but the returns were imperfect, "*the people being deterred by a simple superstition and observation, that the sickness followed upon the last numbering of the people.*" This prejudice was doubtless derived from a passage in sacred history, and has not entirely disappeared at the present day. I have not known of its being met by the census takers of modern times, yet in its application to a count of the converts resulting from a religious revival, it has been gravely objected, that the summary punishment executed upon the Hebrews in the days of King David, should serve as a warning against a similar trespass. The subdivisions of the census of 1712, were into whites and blacks. The former into males and females, and each of these by the ages under 16, — from 16 to 60, and over 60. The blacks were classed as male and female, and of each sex those under and over 16 years of age.

In 1714, a partial census, with a similar classification was made.

In 1723, a census reported the population as whites, and negro and other slaves, and each of these classes as men, women, male children and female children.

In 1731, and 1737, similar censuses were classified in like manner, excepting that 10 years, was defined as the limit of childhood.

In 1746, 1749 and 1756, a classification similar to that adopted in 1712 was used, the ages being those under 16, —from 16 to 60 and over 60, for both whites and blacks.

From 1756, to 1771, there was no enumeration of the population of New York. The census taken on the year last named, was classified like those that had preceded it, thus affording one of the conditions of essential value in statistics, that of *comparability* with preceding returns.

The necessities of the revolution, required a basis for ascertaining the quotas of men and means due from the several colonies represented in the continental congress, and in 1775, that body ordered a census to be taken uniformly throughout the thirteen colonies, by committees appointed in each county. The returns were imperfectly taken, and only fragments of these are preserved. They show that qualification for military service was the governing idea in grouping the ages, which are classed as under 16,—from 16 to 50, and over 50, with the white males, white females, and with negroes, were classed without distinguishing sex as those under and over 16 years of age.

The Articles of Confederation conferred upon congress the power to assign state quotas based upon the white population, and required another census in 1782. It included only the whites, and classed the males as under 16,—those from 16 to 60, and those over 60. It gave a separate classification of refugees from their usual place of abode by reason of the war, and divided the females between those under and over 16 years of age.

In 1783, a modification in the 8th Article of Confederation established a triennial census, of which only that of 1786 was taken. In this the whites were classed as before. The blacks were reported simply by sex, and the Indians paying taxes by total only.

The first Constitution of the state of New York, adopted

in 1777, provided that a septennial census of electors should be taken as a basis of representation in the senate and assembly, and under this authority a census was taken in 1790, 1795, 1801, 1807, 1814 and 1821, a special act being passed for each of these occasions, in which the schedule of inquiries was prescribed.

The enumerations were made by one or more discreet persons appointed in each ward, and written by the superior assessors and town clerk. The blanks were distributed and returned through the agency of county treasurers, and in some case, through the county clerks.

The census under the first state Constitution required only a return of electors, who were divided into four classes, according to their qualifications, viz: —

1st. Those worth £100 ($250) and over, and allowed to vote for senator governor and lieutenant governor.

2d. Those worth from £20 to £100 ($50 to $250).

3d. Those not freeholders, but renting estates with 40 shillings ($5) annually.

4th. Those who did not possess property qualifications, but were freemen in New York city on the 14th of October, 1775, or in Albany on the 20th of April, 1777.

Nothing beyond these inquiries was returned until the fifth census in 1814, when the occasion was improved to ascertain the total population.

The ages of white males and females were arranged with reference to 18 and 45 years, but of the free blacks and slaves only the total was given, without reference to age or sex.

In 1821, upon the last occasion in which a census was taken, under the first Constitution, an attempt was made to obtain statistics of agriculture and domestic manufactures. This attempt may be attributed to the efforts of the state Board of Agriculture, founded in 1819, and then earnestly engaged in efforts to promote and encourage

improvements in agriculture and household manufactures, by the distribution of premiums, and the emulation excited through county societies.

This society attempted to collect through its own agencies, in 1820, a series of statistics upon agriculture, in which the methods of tillage and cost of cultivation of the principal crops were to be shown, and at its own expense issued a circular and schedule for this object. With the exception of the admirable statistical report of the county of Albany by John Preston, and the essays prepared by members of the Board and published in their Transactions, these labors were barren of recorded results. The attention drawn to the subject, may have improved the quality and quantity of our products, but they have left nothing for our comparison. Probably the earliest attempt made in America, to obtain agricultural statistics was by President Washington, who, in the summer of 1791, addressed circulars for this purpose to persons selected with reference to their intelligence in the several states. His questions were eight in number, and referred to the fee simple, prices and rental of farming lands,— their situation and proportions of arable pastures and wood lands; — the average product and market prices of wheat, rye, barley, oats, buckwheat, beans, peas, potatoes, turnips, grasses, hemp, flax, &c., with the common mode of tillage; — the average prices of farm stock (specifying each kind), and the prices of beef, veal, mutton, pork, butter and cheese; — the price of wrought iron used in making farming utensils, and a statement of taxes.

This circular, with its answers, is published in "Washington's Letters on Agriculture, addressed to Arthur Young," and will forever stand a monument of the discriminating sagacity, and exceeding good sense of the illustrious Washington.

The Society for the Promotion of Agriculture, Arts and

Manufactures, incorporated in this state in 1791, soon after its organization, endeavored to collect statistics of husbandry by the aid of circulars, but without published results. Early in 1815, the Literary and Philosophical Society of New York, under the presidency of Dewitt Clinton, issued a circular for obtaining a statistical account of the state of New York. It was prepared with intelligence and embraced a wide range of inquiries relating to local history, natural history, resources and products, the methods and results of agriculture and manufactures, climatology, social and moral statistics, local incomes and expenditures of towns and counties, and in short every thing that could be reached by inquiry, or desired for a gazetteer. These inquires were evidently suggested by the statistical labors of Sir John Sinclair in Scotland, whose publications were presented as a model of excellence.

Many of the inquiries of this circular, were beyond the reach of any national census plan, and to succeed would have required educated experts in every locality addressed.

The returns of the census of 1821, present only the acres of improved land, and the number of neat cattle and sheep. They also show the number of yards of fulled cloth, flannel and linen, or other cloths made in families.

Upon the revision of the Constitution in 1821, a census was ordered in 1825, and on every tenth year thereafter for the purpose of equalization the representation. Aliens, paupers and persons of color not taxed, were deducted from the total, and were therefore necessarily enumerated separately. This provision is still continued, with the exception that paupers, were under the Constitution of 1846, not excluded from representation.

The census of 1825, was taken by "one discreet person to be called a Marshal in each town or ward, appointed by the supervisor, clerk and assessors." The schedules

of inquiry were stated in the act, and from thence found their way into the Revised Statutes first published in 1828–30.

Its results were printed in the appendix of the legislative journals of 1826, a small edition on finer paper being taken from the same type. The classification was meagre; no distinction was made between whites and colored, and the ages by sex were arranged as under 18, between 18 and 45, and over 45. The number liable to military duty, and the number of deaf and dumb, of insane and of idiotic were reported, distinguishing the latter by sex, as under 10, and from 10 to 25. The number supported by charity or by friends was also stated, and a few percentage tables were now for the first time introduced into the state census, showing the relative number of these unfortunates to the total population. Its agricultural statistics, included acres improved, and the number of neat cattle, horses, swine and sheep, and the same results of domestic manufactures as the census of 1821.

The census of 1835 was taken as before, and the blanks were extended to include the blind, and to embrace some nine on ten specific branches of industry, leaving the remainder altogether out of the account.

Its results were printed on one side of a huge page of a thin folio volume, and the arrangement compares strictly with that of the census of 1825, excepting that the number of male and female births and deaths during the year previous, and the number of blind were separately reported. This labor presents no growth of ideas whatever, with this slight exception, so far as applies to personal statistics. In the line of manufactures, it presents the number of establishments and the value of products for twenty different kinds of manufacture, supposed to be most generally distributed. Of cotton and woolen cloths, it also presents the number of yards made.

In 1845 a census was taken by marshals appointed in each election district by the supervisors, town clerk and town superintendent of schools,— and like all the preceding enumerations, upon blanks furnished by the secretary of state.

Up to this period inclusive, the returns were made by families, one line being employed for each, and the number coming within certain ages and classes entered in the columns indicated by the headings. The totals footed up by the marshals, were transmitted by the town superintendent of schools to the county clerk, where the results of towns were collected into a county summary and returned to the secretary's office.

The labors of the central office were therefore limited to the distribution of the blanks, and the construction of a general table for the state, from the tables prepared by the county clerks.

It will be at once seen, that this method afforded no clue to any errors that might have been committed in the primary additions. It is susceptable of easy proof, that such errors occurred, and I can point out one single instance of an error of 10,000 which crept into one of the footings of a town, affecting not only the results of the county, but of the state, to that extent. Nor was this a solitary example of the mischief liable to result from allowing the summaries to be made by many different parties acting without concert, and left to place their own construction upon doubtful entries.

As for its subject matter, the census of 1845, in addition to that of 1835, with which it compared, it gave a rude classification of place of birth, designating state of New York, New England, and other United States, Mexico and South America, Great Britain and its possessions, France, Germany, and other parts of Europe.

It also reported the number of children from 5 to 16,

the number attending common or select schools, academies or colleges, and in agricultural statistics included the acres and product of nine of the principal cereal and root crops. The results of this census were printed in a huge folio volume about the size of a semi-annual volume of the Herald or Tribune. The paper was printed upon one side only, and the headings were unchanged throughout.

In this brief review I have omitted to notice, in its proper relation of time, the Federal census first taken in 1790, and repeated every tenth year since that period. It has been taken by the marshals of the district courts and their deputies, and has formed the basis of representation in congress.

In 1790, the population was reported as "white males 16 and upwards," and "under 16," "white females" without reference to age:—"all other persons," and "slaves."

In 1800, and 1810, the white males and females were separately classed as under 10,—10 to 16,—16 to 26,—26 to 45, and 45 and upwards. Free colored persons and slaves were returned only by aggregates.

In 1820, the whites were classed as before, and the latter by sex as under 14,—14 to 26,—26 to 45, and 45 and upwards.

In 1830, the ages of whites were divided by sex into groups of 5 years to 20, and of 10 years above that age to 100. The free colored and slaves were separately arranged by sex, as under 10,—10 to 24,—24 to 36,—36 to 55,—55 to 100 and 100 and upwards.

The first edition of this census was found so full of errors due to marshals, that a second one was printed, and the two editions are usually found bound together.

In 1840, a classification similar to that of 1830 was employed, with the addition of special inquiries relating to pensioners and their residences.

Manufacturing statistics were attempted in 1810, with

imperfect results. In 1820, the name and nature of articles made, their value, and the kind, quantity and cost of materials was returned, but no general summaries by states were made, and the unsatisfactory result appears to have prevented any thing from being attempted in 1830.

In 1840 inquiries were made into the statistics of mines, agriculture, horticulture, commerce, fisheries, products of the forest and manufactures. The results published in detail scarcely admit of generalization, and on every page bear internal evidence of defective returns.

It may in truth be admitted, that the varied inquiries with which the census has been loaded, have often given in the result just occasion to doubt its general accuracy, and it may be frankly stated as a matter of regret, that any thing beyond personal inquiries have ever been crowded into its columns.

In European labors of this kind, we find nothing beyond statistics of the population, with the manifold combinations pertaining to its origin, distribution, employment, civil and domestic relations and mortality. These, under careful instructions, and taken by competent persons, may afford trustworthy data for valuable generalizations for the guidance of legislators and statesmen. Beyond these, we trespass upon fields of inquiry that should claim the attention of other departments of government.

Statistics of agriculture might better be obtained through the agency of state and county agricultural societies, clothed with legal authority, and with means to defray the incidental expenses. Manufactures having become the subject of taxation, may be more fully reported by our revenue officers, than they ever were by the census marshals.

Having thus briefly noticed the several census returns of the state and national governments down to 1845, I come to a period that is marked by a most radical improve-

ment in the style of schedule used. The census of 1850, employed a blank, which afforded a separate record for each individual of whatever age, in which the sex, age, color, occupation, place of birth, whether married during the year previous, whether owner of real estate, whether unable to read, and over 20 years of age, and whether deaf and dumb, blind, insane, or idiotic were recorded. Columns were provided for numbering the dwellings and families in the order of visitation, thus incidentally affording a knowledge of the number of families to a house, and each page bore the certificate of the marshal.

In like manner the products of agriculture and manufactures were stated opposite the name of each owner, agent or manager of the business, and be that business what it may, the returns, if faithfully rendered, would show to the extent of diversity allowed in the headings, the character and amount of business of the nation.

As is well known, the results, so far as they affected the population, were at length published with comparative and percentage tables.

Of the agricultural statistics, only the more general summaries appeared. The statistics of mortality appeared five years, and those of manufactures nine years afterwards, — an interval sufficient to cancel every feature of value they might have possessed, except for purposes of comparison.

The historian will find it his duty to record, that this suppression of these important national statistics for so long a period, and their final publication in an edition so small that few of those most interested can reach them, may be traced to a jealously of southern statesmen then in office, at the vast preponderance of the elements of productive wealth in the northern states. Time will most assuredly develop the fact, that these vast resources are adequate to the maintainance of our national integrity, notwithstanding the sectional efforts that have been made

for its overthrow; nay, further, that they are as inexhaustable as they are vast, and that with elastic energy they will rise to equal any emergency which our national safety or honor may demand.

The state census of 1855 adopted the schedule of the last Federal census, with the addition of columns for recording the material and value of dwellings, the relation of each person to the head of the family, civil condition, years resident in present locality, native or naturalized voters and aliens. Separate blanks were provided for recording marriages and deaths occurring during the year previous, with their collateral incidents of date, names, late civil condition and place. Other schedules provided for the entry of agricultural and manufacturing statistics, more fully than upon any previous occasion, and for a class of records relating to places of public worship, school houses, unincorporated literary and benevolent institutions, newspapers and magazines, &c., a part of which were now first introduced in the census.

The census marshals in 1855 were appointed by the secretary of state, and usually one in each election district. Their number was 1,744. The enumeration was begun on the 1st day of June, and all the inquiries referred to that date. The labor should have been finished in one month, and in most cases was perfected within that time, but instances occurred from unusual population, and other causes, which delayed some returns till December. The labor of summary and classification was all done in a central office, and begun on the 1st day of August. A Preliminary Report embracing by towns, counties and wards, the political portion necessary to a new arrangement of senate and assembly districts, was printed and laid on the members' tables on the 1st day of the session of the legislature of 1856, and the final report, embracing as full a summary as the data collected allowed, was completed in the summer of 1857.

Specimen numbers of every periodical printed in the state were collected, bound in volumes and deposited in the state library. The original returns filling 87 massive volumes are also substantially bound and placed in the state library. Duplicate copies of the returns of each county were deposited in the office of the county clerk, and by law were required to be bound for preservation.

The printed results were stereotyped, and larger editions were printed. In deciding upon the size of this volume, it was intended that it should not exceed the average of the volumes used for records in the offices where it would be placed, and strict economy of space and arrangement was studied throughout. The reader will nowhere find a table folded, or turned to read the longer way on a page. There are no waste pages or parts of pages where they could be avoided, and there is a thorough index. Much credit is due to the Hon. E. W. Leavenworth, then secretary of state, for the laborious attention which he gave to the details of the preliminary labors, including the selection and appointment of marshals, and the arrangement of forms, and to his successor Mr. Headley, for the liberal interest he took in securing the final publication in a form worthy of the Empire state.

The 8th federal census returned in 1860 was taken upon blanks, and under instructions scarcely differing from those of 1850, and the results are now in course of publication.

The changes in the personal schedule from that of the 7th census, consist in the addition of columns for noting the value of real and personal estates, and of children whether attending school within the year.

The blanks for slave inhabitants, statistics of mortality, agriculture, products of industry, social statistics, colleges, academies and schools, libraries, newspapers and periodicals, religion and pauperism, are copies of those used in 1850.

Having thus briefly noticed the several census returns heretofore made in our state, we arrive at the very important question:—How can this inquiry be made more thorough and complete?

It is obvious that the chief difficulties lie in the procuring of full and uniform data. When the returns are once received, the office details are altogether under control, and the subdivisions of labor, the checks against error, and final combinations and classifications, become matters of accurate and systematic arrangement.

I will therefore limit my remarks to the arrangement of the blanks, and the probable difficulties to be overcome in securing their proper return.

Under the law of 1855, still in force, the preparation of the schedules and the selection and appointment of enumerators, is entrusted to the secretary of state. The law directs that one or more persons shall be appointed in each town or ward. In 1855, this was made to imply one in each election district. It may, if desirable, be extended to school districts, or other small subdivisions of towns, or to one or more blocks bounded by streets in the cities. In these respects the existing law requires no change, and upon a careful and deliberate revision of the law of 1855, I find but two sections that absolutely require modification. One of these, is that fixing the compensation of the agents employed in making the enumeration at $2 per day, a sum which under existing circumstances is too small, and not enough to secure men competent for the work. The other, is a clause making the payment to depend upon the acceptance of the returns. As soon as received, the schedules should be carefully revised by a competent clerk, and if any obvious neglect or error appears, the person making the returns should be required to supply the deficiency, or correct the error. Each clerk of boards of supervisors should receive from the secretary

of state, a certified list of enumerators who have made acceptable returns, and no one should be paid whose name is not on these lists.

The compensation would probably be about $3 per day, or perhaps more in cities.

The ideal of a perfect census, is one taken on a single day, upon schedules distributed before, and collected the day after that fixed for the enumeration. I deem this unattainable, in view of the present circumstances in which we are placed.

Next to this would be, small districts, in which the census could be taken within one or two weeks, but with reference to one day. If the extreme multiplication of districts be found impracticable, we may at least depend upon election districts in towns, and the subdivisons of these in cities, as a basis which has afforded one state census without the omission, so far as is known, of a single district. While nearly every country marshal had finished his labor and filed his returns in duplicate within the month, we found that many of the city marshals were still in the midst of their labors at the end of that period.

The reason of this is obvious. The average population of election districts in the rural sections, ranges from 1,400 to 2,200, while in Albany county it is 3,000, in Erie 3,200, in Kings 8,000, in New York 6,300 and in other densely settled regions it is correspondingly high. In 1855, one marshal in Brooklyn, reported over 10,000 names, while in one of the rural districts a return of less than 300 was received. Under the existing law, discretionary power rests with the secretary to equalize the districts, and this may be done under the advice of judicious friends in every county, who are familiar with the local peculiarities of their vicinity.

In subdividing districts, the greatest care should be taken to leave nothing doubtful about the boundaries.

In general, public roads, canals, rail roads, avenues, or in cities and villages, streets, would be the most convenient lines. Parts of two towns or wards, or other districts whose population should be kept separate, should never be assigned to the same enumerator, and great care should be taken that the whole area of the state be once and only once covered by the districts temporarily established.

The most serious obstacle that lies in the way of a full census the coming year, will be found in the suspicion among ignorant persons, that the enumerations may have connection with some military enrolment for a draft, or for some plan of taxation.[1]

The only remedy against this must depend upon the most positive assurances from official sources, that this census is in no manner caused by, or ordered with reference to the existing war,— but that it is taken under a requirement of the constitution that has existed since the revolution, and that it has for its pecuniary object the obtaining of data for the reapportionment of representation in the legislature. It may in full truth and sincerity be affirmed, that the census is in no sense of the word an appraisal for purposes of taxation, and that it is taken entirely under state authority and for the purpose of affording correct information that may tend to an equal and intelligent administration of our state laws.

The agents heretofore employed in taking the census have usually been called *marshals*. As this term has come

[1] It will be remembered that when this paper was read, and when the instructions and blanks of the census of 1865 were prepared and printed, a draft for half a million of men was impending on the loyal states. Fortunately the war terminated before the census began, or otherwise there would have been found a prohibitory feeling against it, from its supposed connection with the draft. The greatest difficulty that was subsequently met arose from this cause, as the more ignorant classes were still jealous of inquiries so similar to those which had impressed terror upon the popular masses, and which had led in our great cities to the most fearful riots on record.

to be associated in many minds with the conscription, it will be better to drop its use altogether in this connection, and to apply the term *enumerators*, as sufficiently definite, and quite free from objection.

The conductors of public journals, who can have no other wish than to see the census fully and fairly taken, will do the measure great service, by often and clearly informing the public through their columns, of the correct objects and nature of the enumeration, and by removing as far as possible the suspicion of enrollment for military purposes.[1]

In every census hitherto taken, the enumerators have found men at times distrustful in regard to the question asked concerning the details and profits of business.

Every well informed person must know, and those who do not should learn, that the details of individual business are lost in the general aggregates of counties and towns. The returns of the census should be regarded as confidential, and those having access to them as in honor bound, not to allow the prying curiosity of a gossip, or the jealous eyes of a rival, or the greedy search of a creditor, to be gratified by an inspection of these records.

Unless this confidence is felt, the answers to the inquiries of a business character will be evasive or wilfully false, according as the person wishes to be known as doing a large business, by way of advertisement, or a small business for the purpose of avoiding taxes or misleading a rival. Many of the errors of the census of productive industry arise from ignorance on the part of those rendering the information. The answers must in many instances be little better than vague estimates, and often widely differing

[1] A circular was prepared to be addressed to all editors throughout the state, inviting them to a friendly and frequent notice of the purposes and ends of the census, the better to prepare the public mind for the inquiries. The return of peace rendered this circular less imperative, and it was not issued.

from the exact numbers. Yet, notwithstanding this inevitable uncertainty in the primary elements of the summary of national wealth, the results will be found to approximate often very nearly to the truth. The overestimates of one, will balance the short returns of another, and thus in a measure, compensate themselves in the final aggregate.

Legislation can never remedy this defect, which is altogether beyond the power of law to correct or prevent. Few business men keep their accounts of manufactures, of the cost and quantity of raw materials, of the value and amount of manufactured products, or of the price of labor, as an element of the cost of manufactures, with that exactness that might be desired in a census. In the absence of data, what remedy is left to the agent charged with collecting these statistics? The utmost courtesy and willingness, supplies only estimates. It is an easy matter to prepare a set of inquiries, that should furnish the most exact basis for calculating the profits and wants of business: but it is unwise to attempt more than we can rationally expect to accomplish.

I will now proceed to enumerate some of the inquiries which have been included in the census returns of other countries, which I do not deem applicable with us.

In France, and other nations of Continental Europe, a prominent place is given to tables of stillborn, foundlings, and illegitimate children. Under the strict municipal regime which there prevails, these statistics are readily obtained, but with us, however desirable and useful, it is not in the nature of Americans to report frankly and without reserve, every thing they know concerning their own families. The evasions that would be practiced would quickly cancel whatever value there might be anticipated from them.

It would be deemed inexpedient to make inquiries upon

subjects, concerning which, accurate means for obtaining data already exist. The tendency has been to overload the census with extraneous questions, which really impair the accuracy of the whole. I would therefore leave the statistics of schools and school houses, to the organized system of supervision arranged for the purpose. We enquire nothing about commerce, or trade, finances, insurance or of capital or industry of any kind, except as applied to agriculture and manufactures.

Our citizens are jealous above all other people of any interference in their religious opinions, and therefore it would be highly injudicious to include in the census, as has been done in Canada, and in several European countries, any question concerning religious preferences or church membership. Nearly every denomination has its annual statistical reports, and for purposes of illustration these might be freely and properly used in connection with the explanatory introduction. A few questions relating to church edifices, and their accommodation and attendance, have been formerly included and may be continued without objection, yet the official returns of the several sects, collected and published by themselves, would be far more reliable.

The passport systems of Europe present an opportunity of showing the movement of population by travel, to which we were until very recently strangers. The only approach to this, has been the annual statement of immigration obtained through our custom house returns, yet even these were far from being full, as they took no account of the thousands who crossed our northern boundary from Canada unrecorded and unknown.

The ebb and flow of the human tide along our great lines of travel, may in some degree be ascertained from the reports of rail road and steam boat companies, but have never found a place in our census returns, by way of comparison or illustration.

The ages of husbands and wives at time of marriage, the mean duration of marriages, the number of marriages opposed by friends, the number between relatives, the number by which children have been legitimized, the fecundity or sterility of marriages, and other inquiries into the conjugal relation, have engaged the attention of French statisticians, and formed the subject of tabular reports. They may mostly be regarded as inexpedient with us, not from any want of interest that these facts would present, but from the strong probability that they could not be obtained, without diverting attention from other and more important inquiries.

I wish to now invite your attention to certain points in which I think the schedule of the census can be improved without overloading it, and with manifest benefit in the results, and in doing this, I will repeat the headings of the columns used in 1855, with a few words upon each.

1st. Dwellings numbered in the order of visitation.

2d. Material of dwellings.

3d. Value of dwellings.

The first of these was adopted from the census of 1850, and is indispensable. The other two were first used in 1855, and with a result so satisfactory, that they should be repeated for purposes of comparison.

These entries should be made also for uninhabited houses, the remainder of the line being left blank.

4th. Families numbered in order of visitation.

5th. Name of each person, beginning with the head.

These are essential features and serve as a guaranty of the fidelity of the return. With scarcely an exception, a uniform rule was observed in 1855, of arranging first the husband and wife, and then the children in the order of ages. Then followed other inmates and servants of the family. From this alone, the number of children at home, the number of servants, the relative ages of the

married, might be derived, although no separate tabulation has hitherto been made. The cost of this reduction, is a subject of accurate estimate, like most other deductions of the census, and the results are within our reach.

6th. Age of each person. This is entered in the exact year, and has hitherto been classified in groups of five years to 50, and of 10 years above that year. In the coming census, it is proposed to adopt the quinquennial arrangement throughout, thus affording a uniform series for the whole period of life. For a special comparison, the ages, from 15 to 18, and from 18 to 20, will be separately classified. The data are sufficiently definite, to allow the arrangement by single years, but there would appear the inevitable tendency to the returns of ages by the nearest round number. The 30's—35's and 40's, would much exceed the 29's—34's and 39's, or the 31's —36's and 41's. The only way of avoiding this, is to inculcate additional care upon the enumerators, but even then how difficult to get the exact age! It is so difficult to confess advancing years with certain persons, that the precision of the census is gravely impaired by this fashionable perversion of truth.

Another question of vital statistics, here occurs, which fortunately is within easy reach, and which without an extra column in the schedules, and but a word in the illustrations, will enable us to secure the materials for a highly interesting deduction. In 1855, the ages of children if under 1 year were reported fractionably by months, thus $\frac{3}{12}$—$\frac{7}{12}$, &c., which enabled us to know the number of births by months for the preceding year.

During the last four years, our country has been involved in the active scenes of a great national crisis, which has withdrawn several hundred thousand men from our state. What has been the effect of this extraordinary commotion upon the natural increase of our popu-

lation by birth? Is there any truth in the theories of some physiologists, that war has an influence in determining males as the prevailing sex of children born? Are the theories of the economists who have written upon the laws of population as observed in Europe applicable with us?

I propose to suggest, that the age of each child be reported fractionally up to four years, thus $\frac{3}{12}\frac{2}{}-\frac{3}{12}\frac{6}{}$, &c. This can easily be done, and will cover the whole period of the war, showing how many have been born of each sex by months, and what influence if any, the war may have had upon the actual and relative increase or decrease of each of the sexes. Happily with our state, the great leading check upon population, viz. *want of subsistence*, which Malthus places at the head of the list, as the greatest of all causes,—has not been sensibly felt, and we may reasonably expect, that the returns of the coming census, will show a full average natural increase of our population.

7th. Sex. It has hitherto been customary to classify the ages separately by sex, and the returns will be arranged comparable with all former enumerations.

8th. Color. This is incidentally required by the constitution, which excludes from representation, colored persons not taxed. The number by sex, in each town will be separately reported, but in tabulating ages, professions, nativities, &c., no separate arrangement will be made.

9th. Relation to the head of the family. This entry serves chiefly to aid in the classification, and presents no subject for tabular deduction, unless incidentally to show, the number of male and female heads of families, number of children in families, &c.

10th. Place of Birth. This, if in New York, is to be entered by counties; if in another state, by the name of

the state, and if in foreign countries, the specific name of that country. Thus in one column, we obtain the data for an exhaustive classification, comparable with 1855, and by condensation with every thing past.

11th, 12th. Married and Widowed. The latter term includes both sexes, which are determined by referring back to the sex in 7th column. If single, both are blank.

I would here recommend next to these columns, another for "number of times married," the entry to be blank, 1, 2, 3, &c., according to the number of times the person had married. Entries in this column would be made opposite both the married and widowed, and the result costing but a slight trouble, may afford an interesting view of our social condition. To this will be added another column, giving the number of children to which each adult female has been the parent, (including those children absent from home and dead), we should have the data from which an interesting field for statistical deduction will be afforded, and the whole question of fecundity or sterility, the relative natural increase of our foreign and American populations, and I apprehend,—most startling disclosures of the tendency of our social customs and fashions would be shown.

Open the volumes of New England genealogies, and learn from the long registers of children, often averaging ten or a dozen to the family, the reason why New England has been termed the "hive of the human race," and the manner in which she has peopled the rich valleys and broad plains of central and western New York, and the recent empire of the west!

It has of late become fashionable to rear small families. Vast numbers of marriages result in no increase to the population.

Yet this remark does not equally apply to all classes, and already the statisticians of New England, observe that

families of foreign origin, show little or no tendency to an abatement of increase, and that in Boston itself, the Yankee population, in the primitive acceptation of the term, is already far in the minority.

In adopting this heading, much hesitation has been felt, least the delicacy of the inquiry, like that relating to ages, should offend. But with ordinary address, the information may be obtained without its appearing too inquisitive, and in no case except one of illegitimacy ought it to excite distrust. In the present census it may even relieve the subject from any appearance of association with a draft, by giving prominence to inquiries the farthest removed from any military application.[1]

Without varying the schedule of 1858, we shall have the data for ascertaining the number of children of foreign parents of different nationalities but of American birth, among us.

13th. Years resident in present locality. This question was introduced in 1855, but the returns did not admit of comparison on reduction, and it may be properly omitted.

14th. Profession or occupation. This should be retained, and in connection therewith, a column should be added, to show the place of employment, if away from home. This brings us to notice that all persons in the military or naval service, should be reported by the families to which they belong. The civil occupation before entering the service should be given, and the particular regiment or vessel where employed, should be specified.

15th.—16th. Native and Naturalized Voters. These should be taken as in the last state census.

[1] The delicacy anticipated in this inquiry was not noticed in the subsequent operations of the census, and the returns were quite as full as were expected. The draft that impended over the country at the time the above paper was read, was fortunately arrested by peace, before the time for taking the census arrived. It would have most seriously embarrassed, if it did not altogether prevent the census from being taken. (Jan., 1866.)

17th.—18th. Aliens and colored persons not taxed. These questions being required by the constitution, leave us no discretionary power as to their adoption, and a uniform set of rules for their reduction is all that can be done towards perfecting the result.

In the census of 1855, it sometimes happened that a person would be marked as alien, when it appeared he was of native birth, on the converse. It might happen that the column of ages showed a minor, or the wife or minor children of a naturalized voter might be marked as aliens.

In these cases it was assumed that the age, and place of birth were correct, and by a carefully prepared set of rulings, based upon the federal law of naturalization these columns were accurately revised and corrected before any summary was made. Uniformity, and equal justice to every section was thus secured for the representative number.

19th. Persons over 21, who cannot read and write. This is a most valuable item, and will compare with that of 1855 in the reduction. In the federal census, the limit of age is 20 years. The change was made, because our school laws entitle all minors from 4 to 21 to school privileges.

20th. Owners of lands. This will compare with the inquiries of 1850, 1855 and 1860, although the reduction were made only in 1855.

21st. Deaf and dumb, Blind, Insane and Idiotic. Heretofore only one column has been provided for recording these unfortunates, and nothing was enquired of them except what was obtained in the preceding columns on the line of their names.

For the census of 1865, I recommend the following method, and invite for it your careful attention and criticism:

I would furnish only a narrower column, in which to enter simply "1" as an indication that the person has

some one of these infirmities. It also will indicate that something more is to be found concerning him on the fourth page of every sheet, near the bottom of which I would place a table, sufficient for the probable want, and with the following heading.

1st. Page; 2d Line; referring to the page and line, where all the data we have been enumerating have been given, and which therefore need not be again repeated.

3d. Nature of Infirmity, as "Blind," &c.

4th. Duration in years, or if in months, the fractions of a year.

5th. Cause, if known.

6th. If hereditary, name the relationship of those who have been similarly affected.

7th. Now under Treatment. Stating the number of months.

8th. Discharged improved. Stating the number of months since.

9th. Discharged unimproved. Stating the number of months since.

} Treatment at a special asylum or institution.

10th. Private means. This may be stated fractionally as 1, ½, ¾, &c.

11th. Partly at public expense. This may also be stated in fractions if desired.

12th. Wholly upon public expense.

} Upon what dependent for support.

13th. Able to earn a living by his or her own labor. This may be stated fractionally as 1, ½, ¾, so as to express the degree of a liability.

14th. Living in poor or alms houses.

15th. Accustomed to solicit alms.

16th. Remarks. Under this head to be entered any peculiarity which the infirmity may present. Of the insane, the characteristic halucination or tendency, as gentle, violent or destructive, whether confined or at large, whether continuous or paroxysmal, &c. Of the Idiots, whether parents were blood relations, and if so, to what degree, &c.

These statistics, so easily procured in most cases, will afford a large amount of detail, interesting to the en-

lightened philanthropist, the legislator and the officers interested in the care and treatment of these unfortunate classes. This supplementary schedule, occupying less than three inches in breadth, will, in the importance and variety of information resulting, be certainly inferior to none that have preceded it, and as a basis of future history, it will afford data of great interest.

We have been nearly four years engaged in an active and vigorous war, calling forth the best energies of the loyal states, of which we claim New York to be one of the foremost, in men, means and patriotism. We have sent cheerfully to the battle fields of the south, our hundreds of thousands of men. Of these, many sleep in unrecorded graves, or their initials are cut by the hands of loving comrades, on the little headboards of the sacred graves around the camp hospitals at the seat of war, or in the cemeteries of our larger receptacles of sick and wounded in our northern cities. Great numbers have returned home, disqualified from further military service, —and very many are now employed in the armies and navies of the republic.

But the day star of peace is rising, and thanks to the valor of our troops, the bravery and skill of their officers, the firmness and wisdom of our rulers, and above all to the patriotism and sacrificing determination of the *people*, we may reasonably hope, that the census in June next will be taken at the *end of the war*.

Shall we then lose the golden opportunity which this census affords, of learning exactly what has been the influence of this war upon our state, in its resources of men and wealth? What have been its casualties? What its influence upon society?—what upon the condition of our people?

The casualties of war have been greatly over estimated by the public mind. In the Mexican war of 1846–7,

100, 454 officers and men were employed in the armies of the United States. Of these about 52 per cent were discharged on the expiration of their term; nearly 10 per cent before their time on account of disability, 10 per cent died of sickness, 1 per cent were killed in battle, and 0.5 per cent died of wounds received in battle, the remaining casualties being ordinary and accidental, and such as may befall men engaged under exposure and hardships in civil life. The number wounded was a little over three per cent of the total number.

In the present war, we have had enemies still more brave and determined, who were led by officers equally well educated in the art of war as ourselves. The casualties have been relatively greater, but still much less than is generally believed.

I would recommend that the census take cognizance of employment in the military and naval service of the United States, and in this manner:

On the Population schedule is provided, as above intimated, four narrow columns headed. "Now in the army." "Now in the navy," "Formerly in the army," "Formerly in the navy." The instructions will restrict this word "formerly" to imply "in the present war." The figure 1 is to be put here, against the name of every one to whom these headings apply.

On the last page of every sheet there is prepared two sets of headings running across the sheet, and each with a number of lines sufficient for the probable want.

The first of these is for those now in service, and the other for those formerly in service but now out. The questions will be answered by the families to which the persons belonged.

The first and second columns refer to the page and line on the same sheet, where the name and all the details of the population are entered.

The remaining columns enquire when and where, (in what regiment), he entered the service, term of enlistment, first rank, promotions, transfers and reënlistments, and present regiment, rank and unexpired term, with ample room for any "remarks" that the subject may require.

If formerly in service, the blank, after referring to page and line for the name and usual items, requires the following: —

When and where (in what regiment) did he enlist? In what rank and for what term? What charges, transfers and promotions? How long in the service? Did he leave by expiration of term or otherwise? I would not be inquisitive on the question of *how* he left, whether by discharge, desertion, dismission or otherwise, for in some cases this might lead to suspicion, evasion or falsehood. I would prefer to leave this altogether out, in the hope that the returns might show otherwise reliable data. If out of service, the blank enquires in what condition? Health good or permanently impaired? With loss of fingers (as 2 R.—3 L.[1]), hand (R. or L.), arm (R. or L.), foot (R. or L.), or leg (R. or L.)? With wounds (1, 2, 3, &c.) or without wounds? The term wound is defined in the instructions as an injury sufficient to send the man to a hospital.

The statistics of marriages during the previous year differ from those of 1855, in including the names of the parties, and the manner in which the ceremony was solemnized, as "by a clergyman" (giving the initials of the denomination), "by a civil magistrate" (as "J. P." "judge" —"mayors," &c.), or by "declaration before witnesses." A very large falling off in the number of marriages would be expected.

[1] Right, or Left.

The ordinary table of deaths is copied from the census of 1855, adding only the name of the deceased. It includes those of one year, and carefully excludes all that have occurred in the service of the United States, or from wounds or disability acquired in the service.

For these last named casualties, an ample table is provided, extending twice across the page, and designed to embrace all who have died in, or on account of military or naval service of the United States since May, 1861, thus covering, it is earnestly and confidently hoped, the entire period of the war.

The blanks require the name of the deceased, the date, regiment, and rank of first enlistment, months in service, promotions, last rank and regiment, time and place of death, manner of death, as "killed in battle," "died of battle wounds," "killed by accident," or "died of accidental wounds," "died of sickness," "died in a rebel prison," "died after leaving the service," "died of causes unknown." Left a widow? parents dependent (F. M.[1] or 2, meaning both)? Parents not dependant (F. M. or 2)? Minor children (1, 2, 3, &c.)? Dependent sisters (1, 2, 3, &c.)? left none dependent? Was his body sent home for burial? Place of burial? and remarks.

These questions can in a majority of cases be answered by the families of the deceased, and are not complex or difficult. Most of them are answered by a stroke of the pen, as rapidly as they can be asked, and the deductions of which they may be made the basis, will be of inestimable value now and hereafter.

Of agricultural statistics, the same inquiries will be made as in 1855, except that of each crop, the acres sown or planted the year previous, and now in crop, (in June) will be enquired for, with the quantities of each, harvested the preceding year. In like manner, the number of young and domestic animals reared in 1864 and 1865, the number of

[1]Father, or Mother.

cows, sheep, &c., and the number of sheep killed by dogs.

Separate places are provided for entering the number of domestic animals ,(horses, mules and cows), kept in cities and villages, which have heretofore been omitted from want of the agricultural blank, by the marshals in those localities. These in the final tables, will be incorporated with the proper entries of the agricultural blanks.

Of manufactures, the inquiries of the last census will meet the wants of this, but fall far short of presenting a full honest account of these industrial resources of the state.

But there is one measure which will equally apply to special manufactures and special institutions, to which the census may be used in a manner altogether new, yet I feel confident, with full prospect of success. It is this:

The enumerators being all appointed by the secretary of state, and their post office address being known, let a circular be sent to each, asking them to reply by return mail, what of certain of the more common manufactures, and institutions named in the circular there are in his district. Then let a special blank adapted to the particular subject of inquiry be supplied for each, and when filled, let it be at once returned by mail.

The variety and precision of the information thus attainable, cannot fail of being in the highest degree useful to the interests of which they are the subject.[1]

[1] There were fourteen of these special blanks prepared, but on further consideration, two of these (numbers 6 and 11) were not printed. They were numbered as follows: — *Manufactories.* 1. Cheese factories. 2. Cotton factories. 3. Grist mills. 4. Iron furnaces and forges for reducing ore. 5. Lumber mills. 6. Oil refineries; (petroleum.) 7. Paper mills. 8. Tanneries. 9. Wollen factories. *Institutions.* 10. Alms houses and poor houses. 11. Asylums for aged and indigent. 12. Boarding Academies not incorporated or reporting to the Regents of University, or to the common school department. 13. Hospitals. 14. Orphans Asylums. The success of this measure equalled expectations. The use of these blanks, was in fact an approach to the system of taking the census in Europe, where blanks are left to be filled out in each family.

Finally, a few inquiries relating to places of public worship, and to newspapers printed in the district, a few blank lines for noting any causes that may have varied the average mortality, on the harvest of 1864, — the effect of the war upon prices, and remarks generally, will bring the enumerator to the end of his labors. Every page will bear his signature, and the last page his affidavit of the general accuracy of his work according to the best of his knowledge and belief.

The plan I have delineated has been carefully studied, discussed and approved by the Hon. Chauncy M. Depew upon whom the law imposes the responsibilities and direction of this great labor as secretary of state. The legislature have a modification of the law of 1855 under consideration, that will give it effect, and there appears so far as can be seen, the greatest willingness to provide the means for carrying it fully into effect.

In looking over the census labors of other states, it will be seen, that the Empire state, has, true to her motto, far surpassed them all, in the liberality with which she has developed and presented to the world, the elements of every attribute of greatness in her internal improvements, her commercial enterprises, — her manufacturing industry — her institutions, — her schools and her seminaries of learning. It is but proper that the numerical statements of these elements of greatness should be presented, for the admiration and example of her sister states, and for the instruction and improvement of her own people.

Art. V.—*Bibliorum Codex Sinaiticus Petropolitanus The Sinai Bible.* By Howard Townsend, M.D.

[Read before the Institute December 15, 1863.]

Four years have scarcely passed since Dr. Tischendorf, the well known scholar and biblical antiquarian, made his interesting discovery of what will most likely prove the oldest manuscript extant of the Greek scriptures. The story of its discovery seems almost a romance. In the year 1841 Dr. Tischendorf published his first critical edition of the New Testament, and in connection with its publication and in further prosecution of his biblical researches in the year 1844, (having previously visited the public libraries of France, England, the Netherlands and Italy) he went to the Levant, which he was enabled to do through the bounty of the late king of Saxony, and during that tour, whilst sojourning at the Convent of St. Catherine on Mount Sinai, in turning over the contents of a waste paper basket he stumbled upon, to his great joy, several fragments of a very ancient manuscript of the septuagint, a manuscript as he determined not less ancient than the 4th century of the Christian era.

This waste paper basket of the monks was one of their fuel supplies, which was from time to time replenished by such valuable material as portions of manuscripts from their library. Dr. Tischendorf taking these detached portions away with him, published them in fac-simile at Leipsic in 1846.

In 1858, not until after various negotiations and preliminary arrangements, Dr. Tischendorf received permission from the emperor of Russia, to whom he had applied, with

the consent of the king of Saxony, to visit the east with the view of examining and purchasing ancient manuscripts, both Greek and Oriental, particularly such as might be serviceable in promoting the advancement of biblical and ecclesiastical learning. It was not however, until January, 1859, that he arrived again at the convent on Mount Sinai, where he remained several days with his old friends the monks there, but without success in finding the desired treasure which his discovery some years before of the loose portions of manuscript had given him reason to hope for, and despairing of further success, he had ordered his dragoman to fetch his Bedouins with their camels to carry him back to Cairo. When his friend the steward of the convent proposed a walk, during which he intimated to Dr. Tischendorf that he had in his possession a manuscript copy of the Septuagint. Returning to the convent, they proceeded together to the steward's dormitory, where he brought out from a hidden recess the long sought for manuscript, "wrapped up in a red cloth," —a manuscript which Dr. Tischendorf found that the Codex Vaticanus alone could presume to rival in point of age, and in comparison with which even the choicest of the literary treasures of Rome must give place, lacking as they do the Pastoral Epistles, the Apocalypse and other parts of the New Testament, all of which appear in their integrity in this newly discovered Codex.

With the permission of the steward Dr. Tischendorf carried the manuscript to his bed-room, where examining it at his leisure, the value of his discovery became evident, and to quote his own words, he praised and "gave God thanks for bestowing so great a favor upon the church, upon literature and upon himself." He could not think of sleeping, for it seemed to him in such a moment a crime to sleep, so he set himself at work, and spent the night in copying the letter of Barnabas.

The next day he begged the consent of the brethren to his carrying the manuscript with him to Cairo, where he might transcribe it more at his leisure. They were willing to grant this request provided he could obtain the consent of their ecclesiastical superiors. Accordingly on the 7th of February, 1859, he left Mount Sinai carrying with him an official letter from Cyril, the old librarian of the monastery, to Agathangelus, the chief of their ecclesiastical order, residing at Cairo. Agathangelus proved true to his name, "*Good Angel*," and despatched immediately upon a dromedary a courier sheikh to Sinai, who returning delivered the long sought for manuscript into Dr. Tischendorf's hands, within nine days after the doctor's arrival in Cairo.

Immediately Dr. Tischendorf commenced the work of transcribing it, which with the assistance of two of his countrymen he accomplished in the course of two months, and to insure accuracy he compared the copy as it was made, with the original, letter by letter. During which labor Dr. Tischendorf resolved that the manuscript must be brought within the reach and the permanent possession of the learned of Europe, and he commenced treating with the Sinai monks for the transfer of their precious heirloom to the czar, the acknowledged head of their own Greek church.

After many perplexing difficulties embarrassing the course of the negotiations, Dr. Tischendorf was finally successful, and on the 28th of September, 1859, the Codex was placed in his hands at Cairo, to be carried by him to St. Petersburgh for the purpose of publication, and to remain in the keeping of the czar of Russia, until the archbishop, by his official sanction, should constitute it the czar's property forever.

In the middle of October, 1859, Dr. Tischendorf had the honor of placing his Sinai Codex in the hands of the

Czar Alexander, who determined that the public of St. Petersburgh should have an opportunity of enjoying a view of the venerable manuscript. Accordingly it was exhibited for a fortnight in the Imperial Library. The emperor further directed, that immediate steps should be taken for disseminating fac-similes of it throughout the Christian world.

Toward the close of December, Tischendorf carried the manuscript from St. Petersburgh to Leipsic, in order to have the types for his fac-simile founded, and to make the necessary preparations for printing it, at the same time he obtained from De La Rue of London, a paper which De La Rue had lately invented, and which by a chemical process bore a close resemblance to vellum. When all of his arrangements having received the approval of the emperor, he commenced the work in earnest; but so carefully was the whole work executed, that it was not until the end of October, 1861, that Dr. Tischendorf could pronounce it complete, though he had made a great effort to have it completed, in order that it might form an interesting feature in the celebration of the Millenary of the Russian empire, which occurred in September, 1861.

Early in November, Dr. Tischendorf was admitted to an interview with the czar and czarina, and formally presented to them the magnificent monument of their liberality, and the fruit of his learned toils.

The emperor ordered 300 copies of the fac-simile — 200 of these he reserved for the libraries of Europe, and to be otherwise distributed as he might direct. The remaining 100 copies he presented to Dr. Tischendorf to dispose of as he pleased.

While this great fac-simile was in progress, Dr. Tischendorf still kept in view the publication of a common-typed edition of the New Testament portion of the manuscript, which he designed should appear as an appendix

to his larger work, and it is this which has just been published, and which fully justifies the high expectation with which it has been looked for. It is a handsome quarto, and excepting the Old Testament text and the splendid plates of the larger work, contains all of the excellence of that great fac-simile.

In it there is a fac-simile in lithograph of the last 28 verses of the epistle to the Hebrews, which enables one to form a correct idea of the general appearance of the manuscript in its whole extent.

The text, though not in initials, appears in a bold, clear Greek type, and is so printed as to correspond as nearly as possible to the form of the manuscript and its fac-simile edition.

Thus every opening of the volume presents eight columns of text, four to a page, the lines of which exactly correspond with those of the Codex.

The Sinai manuscript — the original — is a large volume of quarto size, the width of the pages being somewhat greater than their length. Originally it was larger than at present, the upper and side margins having been trimmed. The material of which it is made is the dressed skins of animals, chiefly of that kind of antelope which is found in the Arabian and African deserts. Every doubled leaf of the quarto required a separate skin, and to prepare the hides for the stylus, required the best skill of the times.

As the manuscript now is, it consists of 345½ skins, of which 199 belong to the Old Testament, and the remaining 147½ to the New. On every page there are four narrow and very regular columns of writing about 9½ inches long, and 2¼ broad, each containing 48 lines of text. In respect to the number of its page columns, four, this Sinai manuscript is unique. The Vatican manuscript has only three page columns.

The parchment of the manuscript is rather of a light yellow. The ink though usually bright has many hues, from blackish to copper-tinted, and even yellowish; probably owing as much to the diverse nature of the skins as to any chemical difference in the composition of the ink. The Codex throughout is written in uncial or capital letters, initial letters are not used. And originally there seems to have been no interpunction at all, in the manuscript, or what there was occurring only seldom — whole pages being pointless — vacant spaces however, being used for pause signs.

The Codex gives proof of having suffered grievous mutilation, but the New Testament is perfect, having not a chasm in the text from Matthew onward, excepting the book of the Shepherd, which is imperfect.

That which renders the discovery and publication of this Sinai manuscript of such great interest, is the vastness of its age. The proof of which Dr. Tischendorf has been careful to give in his prolegomena, at such length, and so ample and cumulative, as to leave no opportunity for scepticism, excepting with those who are determined to doubt.

The first great seal of antiquity borne by the manuscript, not to speak of the texture and appearance of the vellum of which it consists, is the character of its writing. It is written in Greek uncials or capitals, which at once takes us back over a long train of centuries. Then these uncials are not such as are found upon parchments of the later or even middle periods of uncial writing, but such as are known to be the very oldest which have come down to us. Deciding by the forms and styles of the uncials, which closely resemble those of the Egyptian papyri found at Herculaneum, an experienced paleographer would pronounce the Sinai manuscript to belong to the same cycle with the Alexandrian and Vatican

Codices. Certainly as old as the Vatican Codex, which is now commonly attributed to the middle of the 4th century.

The absence of initial letters is another feature of the Sinai manuscript, declaring its antiquity, because initial letters did not come into use in manuscripts until the 5th century. In a word, the date of the manuscript as fixed by Dr. Tischendorf as at the beginning of the 4th century, consequently in the time of Constantine the Great, and of the first Œcumenical councils.

In the recovery of this long-hidden manuscript, the Christian world has got possession of one of the oldest copies of the Bible, and how interesting is the fact, that that holy mount, hallowed by the far off memories of thousands of years, should again give to mankind, almost as it did in the olden time, through Moses, the inspired teachings and solemn commands of the Deity.

The Sinai convent, where this interesting manuscript was found, is for the weary pilgrims a veritable oasis in the desert. Tradition ascribes the founding of the monastery to the piety of the Emperor Justinian, A. D. 527. The precise period when Christian communities began to settle in the wilderness of Sinai is not fully known, but it was probably during the persecutions which raged in Egypt and Syria, in the first and second centuries. Eusebius quotes authorities referring to them early in the third century. The flight of St. Catharine's body, which according to the tradition of the church was miraculously transported from Alexandria to the top of the mountain, is attributed to the period A. D. 307. The honored relics now repose in the chancel behind the altar. About that period most of the anchorites, attracted by the solitude of the mountain glens and the wild scenery of the rocks, built themselves hermitages there, which finally grew into the conventual establishment now existing.

In the church of the convent is a chapel erected by the Empress Helena on the very spot where stood the burning bush. The place is covered with silver, and all those who enter it, must, like Moses, first remove their shoes, for "the place is holy." Hard by this chapel is a well, which the tradition of the church makes the one from which Moses watered Jethro's flocks.

The library of the convent contains about 1,500 volumes of printed Greek books, and according to Burckhardt 700 manuscripts; but until Tischendorf's interesting discovery of this, which he has called the Codex Sinaiticus, neither books nor manuscripts were supposed to possess any great value.

Indeed a traveler in writing from the convent before Tischendorf's visit says, "There is a library in the monastery, but no one except a stray and curious traveler ever thinks of entering it."

Admission to the monastery can only be gained by producing a letter from the branch convent at Cairo which, when the traveler reaches the convent, he fastens to a rope let down to him from a battlement above, where stand two of the monks reconnoitering. The letter having been closely scrutinized and all found *en regle*, the rope is again let down and to this his dragoman fastens the traveler, when, by means of a windlass he is hoisted up to a dizzy height by a sturdy monk, who drags him in on to the platform. The Bedouin guard, of course, are not admitted, but must pitch their tents outside of the convent walls.

Once in the monastery a sweet sense of repose steals over the pilgrim. He finds everything conducing to a soothing quiet; the deep silence of the building; the moaning of the mountain breeze as it sweeps through the long corridors; the solemn step and sombre costume of the holy fathers; and more than all, the plaintive murmurs of the chanted prayers, as they swell away from the chapel,

amid the death-like stillness of the night, to be echoed by the everlasting mountains around. About the convent of Sinai, there is truly a grand combination of the wild and magnificent in nature mingled with the mystery and awe inspired by sacred associations.

In our narration of this story of the Sinai manuscript we have had frequently to allude to those two old and celebrated codices the "Alexandrinus" and the "Vaticanus." The codex Alexandrinus was sent in the year 1628 as a present to Charles 1st, the king of England, by Cyrillus Lucaris, a native of Crete, then patriarch of Constantinople and previously of Alexandria, sent through the hands of Sir Thomas Roe, the English ambassador at Stamboul the court of the sultan. Of its previous history very little is known. It received the name Alexandrinus, because of its having been brought by Cyrillus from Alexandria to Constantinople. It bears upon it an Arabic superscription mentioning that the manuscript was said to have been written by Thecla the martyr.

Besides the LXX version of the Old Testament (defective in part of the Psalms), the Alexandrinus contains all the books of the New Testament in which though there are a few chasms. The mauscript is on thin vellum; the writing on each page being divided into *two* columns. The letters are round, and possess the characteristics of other documents of the oldest class. They are larger than those of the Vaticanus. The number of lines is about 50 in each page. There is no division of words, and of interpunction only occasional and faint traces.

This was the first manuscript of great importance and antiquity of which any extensive use was made by textual critics. Its actual age was often discussed, and it was variously estimated according to the desire of those using it, either to establish or to oppose its authority and value.

But by the best authority of the present day, this manuscript is thought to have been written about the middle of the fifth century.

Until the Sinaiticus was found, the Alexandrinus was pronounced as the one of all the uncial manuscripts containing the new Testament in by far the most entire condition, none other having the book of Revelation complete.

Bibliorum Codex Vaticanus.—This manuscript is in the library of the Vatican at Rome, where it must have found a place soon after the formation of that library by Pope Nicholas V. Early in the 16th century it was well known by report amongst scholars, as being an extremely ancient copy of the Scriptures.

When Erasmus was censured for having departed in his published Greek Testament from the common readings of the *vulgate*, he appealed to this manuscript as an authority in his favor, because of its great antiquity. The Vaticanus contains the Septuagint version of the Old Testament (defective though through the greater part of Genesis as also in portions of the Psalms), and it contains the New Testament as far as Hebrews ix. 14.

The manuscript is on very thin vellum; the letters are uncials, small, but regularly formed; three columns on each page excepting in some of the Stichometrical or verse parts of the Old Testament, where there is only room for two columns. The manuscript is devoid of interpunction, and the only approach to it is found in a small space being left between the letters where a new section begins.

The antiquity of the Codex Vaticanus is shown by its paleographic peculiarities, the letters resembling, in many respects, those found in the Herculaneum rolls. The form of the book, the six columns at every opening, giving it a close resemblance to a *rolled* book. This, with the uniformity of the letters, and the absence of all punctuation, have their united weight in pronouncing this, until the Sinaiticus, older than any other manuscript known or available for New Testament criticism. And the examination

of its text and contents would prove that it is a manuscript *anterior* to the middle of *the fourth* century, and how much older it may be, there are no means of determining.

In the year 1836 much interest was excited by an announcement by Dr. (since Cardinal) Wiseman, that Cardinal Mai was engaged on a new critical edition of the Greek Testament of the Codex Vaticanus with the view of publishing it. For reasons unknown, this plan was not carried out; but when Rome was in the hands of the Republican Government in 1848-9, Cardinal Mai offered (which had never been done whilst the Pope could exercise his supreme authority), the impression of his fac-simile of the Vaticanus, for sale to Mr. Asher, the publisher, at Berlin. With the French occupation of Rome, however, and the restoration of Papal authority, Cardinal Mai was prevented from completing his plans of publication, perhaps from the same reason that Cardinal Bellarmine, who was ordered by Pope Paul V to superintend the printing of an authentic and faithful edition of the New Testament in Greek; but when "the work was finished, and corrected with the strictest care, so as to be ready for the press, the Pope who had ordered it, 'Cambiato pensiero, piu non la volle,' changed his mind and no longer wished it."

Since then, though, a reprint of the Codex Vaticanus has appeared, from which an edition has been published in London and also in New York.[1]

Besides these manuscripts of the most ancient class, which contain a large part at least of the Gospels, there are several *fragments* which, because of their antiquity, must be placed in the same rank. But of one only will we speak, and with it terminate this long narration.

It is the fragment of a manuscript known as the Codex Purpureus, N being its letter. Four leaves of which are in the Cotton library in the British Museum (conse-

[1] A copy of this and also of the Alexandrinus, from Dr. Townsend's library, were exhibited to the Institute.

quently called Codex Cottonianus), six leaves are in the Vatican, and two are in the Imperial library at Vienna. Its date is the end of the sixth century. This manuscript was written on purple vellum (whence it derives its name), in letters of silver.

These once bright silver letters are now all blackened, the effect of the fire which consumed a portion of the Cotton library. But the words *God*, *Christ* and *Holy Ghost*, having been written in letters of gold, remained unaffected by the sulphurous fumes, retaining their original luster, these sacred words now illumine the blackened mass, just as in Moses's day the Shekinah illumined the dark clouds of Sinai.

Art. VI.—*Food and its Digestion.* By Howard Townsend, M.D.

[Read before the Albany Institute,—Feb. 1865.]

Though this is a subject belonging more strictly, and more appropriately, perhaps, to a lecture in the amphitheatre of the Medical College, yet one feels somewhat emboldened to present it to a cultivated society like that of our Institute, when we learn that even the public at large has taken so great an interest in such like subject, that a clever little pamphlet lately published in London, entitled *A Letter on Corpulence*, by William Banting, has already passed to its 3d edition, and into the hands of some 50,000 individuals. "Bought up," as a late review expresses it, "at the book-stalls as light pleasant reading, in preference to the creation of novelists or the narratives of travelers."

This letter on corpulence, though evidently not written by a scientific man, most clearly and cleverly expresses the views of a man of more than ordinary mind, possessing no little originality, who, to quote his own language, thinks "that of all the parasites which afflict humanity, he knows not, nor can imagine anything more distressing than that of obesity," and he further adds, "Having just emerged from a very long probation in this affliction, I am desirous of circulating my humble knowledge and experience for the benefit of my fellow-men, with the earnest desire that it may lead to the same comfort and happiness which I now feel under the extraordinary change."

"Obesity," he continues, "seems very little understood by the faculty, or by the public generally, or else the faculty, long ere this, would have hit upon the cause of so lamentable a disease, and applied effective remedies

thereto, and the public would have spared their injudicious indulgence in remarks, and sneers most painful, having upon the strongest minds even a most unhappy tendency."

Though a man of evident sagacity and much common sense, Mr. Banting felt that for any valuable or practical information upon this subject which so deeply interested him, he must apply to those who had made it a study of life. With this view he sought the advice of several eminent medical men, "many high orthodox authorities, never any inferior adviser; but all in vain." Most of them recommended great care about excessive eating and drinking, above all things insisting upon increased bodily exercise, which latter part of the advice he closely carried out, and as he graphically states, "It is true I gained in muscular vigor, but likewise in prodigious appetite, which being absolutely compelled to indulge, I consequently increased to such a degree in weight that I was necessitated to discontinue the course." Finally almost discouraged with his want of success, he applied to Dr. Harvey of London, who without restricting him materially as regards the amount of his food, absolutely forbade his using those articles of food which the chemists designate the carbo-hydrates and hydro-carbons, and which the physiologists call fat-producers.

When Mr. Banting commenced his system of training — this reducing process — he was 66 years old, about 5 feet 5 inches in stature, and weighed 202 pounds. Adhering rigorously to the regimen, he brought himself down to 167 lbs. and reduced the admeasurement of his waist 12¼ inches. This diminution of weight was progressive at the rate of *one pound* per week, "until finally" quoting again his felicitous language, "he reached that happy medium, for which, for the last thirty years he had labored in vain, until thus it pleased Almighty Providence to direct him in the right and proper channel of happy comfortable existence."

Previously to this last successful course all the efforts which he made to reduce his "too solid flesh" were unavailing, though he rigorously adhered to the rules laid down for him. "But," again quoting Mr. Banting, "the soil of corpulence would still increase, and like the parasite barnacle on the ship, if it did not destroy the structure, it obstructed its fair comfortable progress in the path of life."

Mr. Banting says his former dietary table was: bread and milk for breakfast, or a pint of tea with plenty of milk and sugar, and buttered toast.

Meat, beer, much bread, of which he was always fond, and pastry for dinner.

The meal of tea similar to that of breakfast and generally a fruit tart or bread and milk for supper, and, he adds, "with this I had little comfort and far less sound sleep."

Under his new regimen he was advised to abstain as much as possible from bread, butter, milk, sugar, beer and potatoes, all of which are largely composed of oily, starchy and saccharine compounds, all tending to increase fatty deposit. The ordinance for this new regimen was as follows:

For Breakfast, I take four or five ounces of beef, mutton, kidneys, broiled fish, bacon, or cold meat of any kind except pork, a large cup of tea (without milk or sugar), a little biscuit or one ounce of dry toast.

For Dinner, five or six ounces of any fish excepting salmon, any meat excepting pork, any vegetable except potato, one ounce of dry toast, fruit out of a pudding, any kind of poultry or game, and two or three glasses of good claret, sherry or madeira; champagne, port and beer forbidden.

For Tea, two or three ounces of fruit, a rusk or two, and a cup of tea without milk or sugar.

For Supper, three or four ounces of meat or fish, similar to dinner, with a glass or two of claret.

For Night-cap, if required, a tumbler of grog, gin,

whisky or brandy, without sugar, or a glass or two of claret or sherry.

With regard to this regimen he expressively adds, "That man must be an extraordinary person who would desire a better."

In amount, the regimen consisted of about five or six ounces of solid, and eight of liquid food for breakfast, eight of solid and eight of liquid for dinner, three of solid and eight of liquid for tea, four of solid and six of liquid for supper, or in all twenty ounces of solid and thirty of liquid food during the day. Though he states that he was not so much limited in *quantity* at either meal so long as the *nature* of the food was rigidly adhered to.

Mr. Banting terminates his interesting account in these words:

"I have never lived so well as under this new plan of dietary, being much better, bodily and mentally, than in other days; and though at 65 years of age, not expecting to remain free from some coming natural infirmity to which all flesh is heir, at this present moment I can not complain of one. It is truly miraculous! and I am grateful to Almighty Providence for the result, and as a thank offering I place £50 in the hands of my medical adviser for distribution in his favorite hospitals, still remaining under overwhelming obligation to him for that care and attention which I can never hope to repay." With this enthusiastic apostrophe of gratitude we will take leave of Mr. Banting.

But before entering upon the subject of food and digestion in its physiological aspect we will briefly consider *Cornaro's* most interesting account, and rules for ensuring a long life. Cornaro's book "*Discorsi della vita sobria*" is the eulogy of sobriety, and he has always been considered high authority on the subject of longevity and temperance, for he, by dint of care diet and moderation, and by making *living* the great business of his life, attained the age of nearly 100 years.

Luigi Cornaro was a Venetian nobleman born in 1468, and having indulged in all sorts of excesses, at 35 years of age became a confirmed dyspeptic, and for the period of five years, in his own language, "life became a torment to him," when he resolved to restrict himself in his diet to twelve ounces of solid food and fourteen of liquid per diem, dividing that amount between four meals. He was immediately restored to health, and when 83 years old, wrote his celebrated treatise *On the Advantage of a Temperate Life*, dying when past 98 years old, in the full vigor and perfect use of all his faculties.

As a necessity of existence, food is only second in importance to atmospheric air. A few days deprivation of it will produce death. The tissues of the body require renewal, and the heat of the body, 98° to 100° Fahrenheit, must be maintained, for both of which reasons food is taken, and for these alone should it be taken, for these are its legitimate object, and when food is taken for these only, it rarely happens that disease is the consequence, whereas if indulgence of the appetite be based upon sensual gratification, then disorder of almost every function of the body, and even structural or organic disease may result.

In the animal economy, income is regulated by expenditure, and the ingestion of food replaces that loss of substance which the body is continually undergoing.

What is food? In the ordinary sense of the word common experience suggests a sufficient answer. "The solid nourishment taken by the mouth into the body." That the word food, however, has a larger meaning, one which more closely approximates its physiological import, a moment's consideration will prove. For example, milk we know is the food of the infant, and in thus regarding it, we ignore the conventional antithesis between food and drink. Indeed the shadowy character of the boundary line between food and drink is well illustrated by the facility with which the great Spanish Casuist Escobar, reässerted the rights of outraged nature on the principle

"*Liquidum non rumpit jejunum*," and consequently permitted his devout co-religionists to fast on the very stiffest of chocolate as being drink and not food.

Physiology declines to distinguish between food and drink, or if it use the latter word at all, would limit it to distilled water devoid of all dissolved solids. Drink then in the physiological sense is included in food.

The most natural division of food would be into the animal, vegetable, and mineral substances.

These three kingdoms of nature all contribute to the sustenance of man.

In the cold regions of the earth, he lives almost wholly on animal and mineral food. In hot climates on vegetable and mineral, and in the temperate regions his food is from the animal and vegetable kingdoms, mingled with a due proportion of inorganic matter.

It is very difficult to make any classification of those substances taken as food which is altogether unobjectionable. It has been attempted on a supposed physiological basis, dividing the substances into the *histogenetic*, or those supposed to aid solely in the *formation of the tissues*, and the *calorifacient*, those maintaining the *heat* of the body. But such exclusive division is not practicable, because it is now known that those substances which are preëminently tissue forming or histogenetic (likewise contribute to produce heat), and those which are mainly calorifacient in their action — heat producers — also contribute to the formation of the tissues.

A more convenient classification is based upon the predominance in the food of some one or more of the elements which give an individuality to the group of articles in which they are found.

Food of every variety when analysed is resolvable into four elements, which are *carbon*, *hydrogen*, *oxygen* and *nitrogen*, combined with certain minerals. These, in the great balance of organic nature, whether in the *atmosphere*, in *water*, in *plants* or in *animals*, play the principal part.

Those substances which are characterized by the presence of *nitrogen*, such as albumen, musculin, casein, gluten and others, are principally of use in forming tissue, though they also aid in sustaining the heat of the body.

The *fats*, composed of carbon, hydrogen and oxygen — sometimes called *hydro-carbons*, are preëminently heat producers, and yet they are essential to the formation of tissue.

The *amylaceous*, or starchy and saccharine groups, also called carbo-hydrates, are mainly useful for the production of heat, though they likewise enter into the composition of some of the tissues. Now to these we must add such inorganic substances as water, and certain minerals.

The demand for food is always regulated by the waste of the tissues, hence the process of growth requires constant supply, and this too, is increased or diminished by the condition of the respiration and the amount of bodily or mental exertion, all of which circumstances induce a loss of force and likewise of texture.

In endeavoring to ascertain what may be the best kinds of food requisite for meeting these demands, the following circumstances must be regarded:

First. The chemical principles which enter into the composition of the living being which is to be nourished.

Second. The mode in which these are combined to form tissues and organs.

Third. The *atmosphere* surrounding the living being.

Fourth. The amount of waste produced as among men variously employed.

The chemical principles are the *albuminous*, the *fatty*, *saccharine* and *mineral*, and of all articles of food *milk* appears to be that one which contains these essential substances in the best proportion. No *one* of these groups of principles alone will serve to keep up nutrition in an animal body, they must be united as milk illustrates. Its *casein* being the albuminoid principle, its cream being the oleaginous, and the sugar of milk the saccharine, together with the mineral principles which are held in solution.

These separate principles in their uncombined form are not generally palatable, nor in the best state to be acted upon by the digestive juices. Nature has mingled them so as to adapt them to the taste, and also render them better fitted for the purposes of life; and man seemingly instinctively, mingles them, so as to form compound substances capable of fulfilling all the requirements necessary in food. For example, bread and butter which is so generally eaten throughout the world, will well illustrate this fact. In bread we find the albuminoid principle in the gluten of the wheat, the saccharine, in the starch; and also in the flour are found the mineral principles, to all of which man instinctively adds butter, which is the oleaginous principle.

Magendie, the French physiologist, to prove the necessity of the combination of all these elements in food, performed some interesting and instructive experiments. For example, he fed dogs upon sugar, oil, and butter alone —carbon and hydrogen elements—and found that for one or two weeks they did very well; but after that period became weak and emaciated, and died after the diet had been thus continued for a period of from 32 to 36 days. Fed upon white bread and water, they lived for 50 days; if cheese and white of egg were added to the diet, they lived a few days longer. No diet will prove nutritious, no matter how rich it may be in any one of these nutritive elements, unless there be the correct combination of all, as we see exemplified by nature in milk, and as man combines when he eats bread with butter, where we have the nitrogenous principle in the gluten of the wheat, the carbo-hydrate in the starch of the wheat with its mineral principles, and added to them the hydro-carbon of the butter.

The atmosphere which an individual breathes exercises a very important influence on the nature and quantity of the diet. When the air is cold and condensed, there will be necessarily a larger amount of oxygen inspired, which

combining with the tissues, produces greater waste, consequently a larger supply is necessary principally of such food as will rapidly produce carbonic acid. This explains why so large an amount of animal and fatty food is consumed by nations inhabiting cold regions, and why in our own climate we can use so much more of these in the winter season than in the summer, why the Greenlander so enjoys the fat of the seal, the blubber and the train oil, which become so disgusting to those inhabiting warmer climates. With these nations too, alchohol in all its various forms (carbon hydrogen combinations), will be used with greater freedom, being useful like fuel for combustion. In the hot climates, where the air is more rarified, consequently less oxygen inspired in the same period of time, a vegetable diet is largely used, and which though abounding in sugar and starch, carbo-hydrates, it is more slowly digested, consequently not so readily converted into matter for combustion.

The degree of bodily or mental exertion, influencing the muscular and nervous textures, influences the kind and the amount of food requisite. Where the time is occupied in either kind of labor, more food will be required than where the time is passed in idleness. This has been proven in a variety of ways: for example, comparing the dietaries of able-bodied men, like soldiers, with that for prisoners it is found that an able-bodied man will require from 31 to 38 ounces (2 lbs. 6 oz.), of dry nutritious food daily—of fluids 52 ounces—over 3 pints. In prisons somewhat less is needed, though here, reducing the amount below 30 ounces daily, will induce scurvy.

But the nutritious character of any substance, or its value as an article of food, does not depend simply upon its containing either one of these alimentary elements of which we have been speaking in large amount, but upon its containing them all mingled together, in just such proportion as is requisite for the healthy nutrition of the body. No chemical analysis can determine this propor-

tion, we can only learn it by observation and experiment.

A necessary condition in estimating the value of any substance as an article of food, is its *digestibility*. A vegetable or an animal tissue may contain an abundance of albuminoid or starchy matter, and still at the same time be of such unyielding consistency, as to be insoluble in the digestive fluids, and therefore prove useless as an article of food.

Consequently, any process which softens or disintegrates a hard alimentary substance, renders it more digestible, and increases its value as an article of food. The preparation of food by cooking therefore, is a very necessary process, though doubtless in its refinement, too often is its good perverted. Two objects are accomplished by cooking — first the food is softened and disintegrated, so that its particles may be more fully and effectually acted upon by the gastric juice in the stomach; and again, by the process of cooking, generally an agreeable flavour is imparted to the food, which flavour stimulates the gastric follicles to pour out an increased flow of their digestive fluid.

By a chemical analysis of food, we gain much positive information as regards the nutritive qualities of the different kinds which we use, and by our advances in physiological knowledge, we have learned much in reference to the adaptability of food to the different requirements of the system, and yet for much valuable information we have had to rely upon fortunate experiments, such as Dr. Beaumont, of the United States' army, performed upon Alexis St. Martin, a Canadian, who was wounded by the accidental discharge of his gun at Michilimackinac, Michigan, in 1822, whilst Dr. Beaumont was stationed there, and under whose charge St. Martin was placed. Though the contents of the gun made a perforation through the walls of the stomach, the man survived, but this perforation was never closed, consequently through it

Dr. Beaumont was enabled to make his examinations, and perform his interesting and valuable series of experiments. Introducing the various kinds of food through this aperture into the stomach, and then watching the result of the digestive process, he ascertained many valuable facts; for example, in the digestion of vegetables, for rice boiled, only *one* hour was required, whilst for boiled cabbage it took *four and a half* hours to complete its digestion.

For Venison steak, broiled,	1 hour 35 min.
" Pork,	5 hours 15 min.
" Roast Beef,	3 hours.
" Milk boiled,	2 hours.
" Milk not boiled,	2 hours 15 min.
" Chicken fricaseed,	2 hours 45 min.
" Turkey roast,	2 hours 30 min.
" Ducks "	4 hours.
" Potatoes * boiled,	3 hours 30 min.
" " roast,	2 hours 30 min.
Bread,	3 hours 30 min.

It is exceedingly interesting to compare the result of these experiments performed by Dr. Beaumont upon Alexis St. Martin, and observe how closely that result coincides with the instinctive experience of mankind.

The Indian and also the hunter has often been heard to remark—without ever having had the opportunity of looking into the stomach—that for the toil and hardship

* The potato is the starchy tuber of a plant belonging to the poisonous genus of the solanum. Perhaps there is no article of food which more strongly claims the attention of the educated public, than does this vegetable. Certainly there is none which better illustrates the intimate casual relation between the food and the habits, the physical and the moral state of nations. It was introduced into Europe from America, by Hawkins, 250 years ago. Throughout many parts of Europe the poorer classes have for years been relying chiefly upon the potato for their nutrition.

Cobbett long ago pointed out the danger of this procedure, because of the insufficiency of this vegetable to replace the more nourishing articles of food like wheat and corn. But it was not until the terrible climax of the Irish famine, that the world became aroused to the danger of trusting to the potato as a staple of food. The physiologist knowing the composition

of a long tramp, he must have something which would "last him longer" than the meat of the deer, which Dr. Beaumont found was digested in an hour and a half, and surely no ocular demonstration is necessary to prove to one who makes the essay, that pork and boiled cabbage require a longer time and greater effort of digestion than roast beef and potatoes — the experience of the sensations is sufficient.

Digestion is that process by which the food is reduced to a form in which it can be absorbed from the intestinal canal, absorbed by means of the lacteals and bloodvessels. (The word comes from the Latin *Digĕro gessi, gestum*, to force apart, separate). This is a process peculiar to the animal kingdom — it does not occur in the vegetable kingdom — vegetables being dependent for their nutrition upon a supply of inorganic substances, such as water, saline matters, carbonic acid, and ammonia. These materials constitute the food on which plants subsist, being converted in their interior into other substances by the nutritive process. These materials are being continually supplied to vegetables under such a form as can be readily absorbed.

Carbonic acid and ammonia exist in the atmosphere under a gaseous form, and they are also found in solution along with the requisite saline matters in the water with which the soil is penetrated. All these substances are therefore at once ready for absorption by the vegetable.

of this vegetable, will range himself with the political economist in his determined opposition to the use of it by any population as their principal article of food, because he knows that the potato is wanting in some of the most important saline constituents of the body, the phosphates, sulphates and chlorides — e. g. a given weight of potatoes contains scarcely $\frac{1}{10}$ of the phosphate of magnesia present in the same quantity of wheat, and we may calculate about 13 pounds of potatoes as the quantity which a man ought daily to consume, in order to replace the waste of the body by a sufficient supply of histogenetic constituents in his food. But the mixture of the potato with other alimentary substances, especially with meat or milk, will remove all these objections, and restore it to its proper rank in the scale of diet.

But with man and animals it is different, they cannot subsist on the *inorganic* substances alone, but need for support materials which have already been organized, and which have previously formed a constituent part of animal or vegetable bodies.

In animals the food required must undergo a process of digestion or liquefaction, before it can be absorbed, the general characteristics of which in all cases are the same.

Digestion is accomplished in the alimentary canal, where the food is brought under the action of certain digestive fluids, which liquefy and dissolve it. These fluids are the secretions from the mucous membrane of the alimentary canal, and those glandular organs contiguous, which pour their secretions into this canal.

Because the food, as we have seen, always consisting of a mixture of substances having different physical and chemical properties, the digestive fluids necessarily must differ materially from each other, each one exerting a peculiar action, which is more or less limited to particular species of food.

The different elements of the food are digested in different parts of the alimentary canal, by the agency of these different digestive fluids, and by their action the various ingredients of the alimentary mass, are successively reduced to a fluid condition, so as to be taken up by the blood vessels, and the absorbent vessels of the intestinal mucous membrane, thus to be introduced into the general circulation.

The action which is exerted upon the food by the digestive fluids, is by no means that of a simple chemical solution. It is an actual transformation, by means of which the ingredients of the food are altered in character, at the same moment that they undergo the process of liquefaction.

The active agent in producing this change, in every instance, is an *organic* principle entering as an ingredient into the digestive fluid, and which by coming into contact

with the food, exerts upon it a *catalytic* action, and transforms its ingredients into other substances — "*Catalysis*, (Κατα λυω, I dissolve or decompose), the action of presence in producing decomposition. *Catalytic force* resolves other bodies into new compounds by mere contact or presence, without itself experiencing any modification."

The newly formed substances, resulting from this catalytic action are absorbed by the vessels, and finally mingled with the general current of the circulation, as blood, by which the system is nourished and sustained.

The food in order to be digested, is acted upon by no less than five different digestive fluids.

First, the *saliva* in the cavity of the mouth. Second, the *gastric juice* in the stomach. Third, the *bile* from the liver. Fourth, the *pancreatic* fluid from the pancreas. Fifth, the *intestinal secretions* from the follicles in the intestinal canal.

The saliva acts upon the *starchy*, carbon and hydrogen elements of the food, converting them into sugar. This action, though not so marked as the action of the secretions further on in the alimentary canal, is one of no little importance, and doubtless some of the forms of indigestion which the physician has to combat in his practice, are a result of the useless expenditure and waste of this secretion in the habit of smoking, and more particularly the habit, almost peculiar to this country, of chewing tobacco.

The composition of saliva, according to an analysis of Bidder and Schmidt, is as follows:

Water,	995.16
Organic matter,	1.34
Sulpho cyanide of potassum,	0.06
Phosphate of soda, lime, magnesia,	0.98
Chlorides of sodium and potassium,	0.84
Mixture of epithelium,	1.62
	1000.00

The *gastric juice* acts upon the albumenoid (nitrogen) ele-

ments, like the gluten in bread, casein in milk, and its composition is as follows:

Water,	975.00
Organic matter (pepsin),	15.00
Lactic acid,	4.78
Chloride of sodium,	1.70
" " potassium,	1.08
" " calcium,	0.20
" " ammonium,	0.65
Phosphate of lime,	1.48
" " magnesia,	0.06
Iron,	0.05
	1000.00

In a healthy human adult the quantity of gastric juice secreted in 24 hours probably ranges from 10 to 20 pints; its maximum, in an hour, under favorable circumstances, not less than from 6 to 8 pints.

Of the action of the *bile* in the process of digestion, much has yet to be established, but that it exercises a stimulating influence upon the absorbents of the intestinal canal is fully proven.

The composition of the *pancreatic* juice which digests or rather emulsionizes the fatty (hydro-carbon), elements of food, which action has only been determined within the last few years by Prof. Bernard, of Paris, is as follows:

Water,	900.76
Organic matter (pancreatine),	90.38
Chloride of sodium,	7.36
Free soda,	0.32
Phosphate of soda,	0.45
Sulphate of soda,	0.10
" " potassa,	0.02
Combinations of lime,	0.54
" " magnesia,	0.05
" " oxide of iron,	0.02
	1000.00

The secretion from *follicles* of the intestine canal continue and complete the digestion of the *starchy* (carbo-hydrates), elements of the food.

As a general rule, the digestive apparatus of the herbivorous animal is much more complicated than that of the carnivora. In vegetable substances, the nutritious matters are frequently present in a solid and inconvenient form, as for example in raw starch and the cereal grains, and are almost always entangled among vegetable cells and fibres of an indigestible character. In those cases where the food consists mostly of herbage, or grass and leaves, the digestive materials bear only a small proportion to the entire quantity, consequently a large mass of food must be taken in order that the requisite amount of nutritive material may be obtained. In all these cases, the alimentary canal will be found large and long, and also divided into many compartments, wherein the different processes of *disintegration*, *transformation*, and *solution* are carried on.

In the carnivora the alimentary canal is shorter than in the herbivora, and it presents fewer complexities. The food upon which the carnivora subsist is softer than that of the herbivora, and also it is less encumbered with indigestible matter, consequently the process of its digestion, requires a less extensive apparatus.

Note. — The Preparations and Apparatus used in the illustration of this paper, were from the Museum and Laboratory of the Albany Medical College.

Art. VII.—*An Essay on Motion and Force, By* L. Allen.

[Read before the Institute, 1865.]

Gentlemen: It is with extreme diffidence that I venture to present to you some thoughts upon a subject which has occupied my mind for a considerable period of time, and upon which, after careful, although from the nature of my daily avocation, somewhat desultory reading and study, I find myself compelled to differ from others on points which occupy an important place in the foundation of all natural science.

To those whose minds have been directed to other fields of investigation, the topic I shall discuss in this paper, which I have styled *An Essay on Motion and Force*, may prove somewhat uninviting. I therefore beg the indulgence of such, to what may prove a tiresome discussion, and of all, to the rambling character of a paper, written at distant and irregular periods, which, under such circumstances, could scarcely evince that unity which is the result of continued effort in the same direction. I also realize its incompleteness. So important a subject can scarcely be more than glanced at within the limits to which I have proscribed myself; and yet I have omitted many portions which were originally intended to form a part of this essay, in the fear that I might trespass too much upon your patience.

In supporting the points which I shall endeavor to maintain, I assume as a postulate the existence of matter Whatever may be the opinions or speculations of men upon the essential nature of matter, whether it be the result of forces acting in opposition to each other, or something which is beyond the reach of science, there is

confessedly something which our senses perceive, *and that something*, which is what I mean by matter, *moves.* I have no desire to step over the strict line of demarkation which seperates the physical from the metaphysical. I have no wish to follow in the track of those, who, standing upon the verge of the precipice which limits human understanding, and reaching out arms into the unfathomable darkness, have mostly toppled into the abyss of hopeless bewilderment. I shall therefore avoid the discussion of all metaphysical questions, and confine myself strictly to physical phenomena and theories based upon them. I shall also assume the atomic and molecular condition of matter, since whether the truth of the atomic theory, strongly questioned by Grove and others, be admitted or not, it will not effect the doctrines I shall support in this paper, and these terms, in the absence of better terminology, afford a convenient mode of expression.

I shall divide motion into two general classes. *Atomic motion*, or motion of ultimate particles, and *aggregate motion*, or motion of matter in masses; and make here this first proposition. *All change which matter undergoes is motion*, and conversely all motion is change.

I use the word change in the sense of passing from one state to form another, or from one position to another, and not in the sense of the variation of form, quality, or essence, which a body has sustained by previous motions, and which characteristic properties it possesses as a result of those motions; although if the atomic theory should ever be satisfactorily proven, it will doubtless be discovered that even in the latter meaning of the word, change is motion and motion is change.

Molecules, if there be molecules, are of course matter in a condition of aggregation, although perhaps not technically so considered; but as it is necessary to distinguish molecular motion, from the motion of bodies which are sufficiently large to be sensible, I shall further divide aggregate motion into molecular motion, and aggerose

motion, or motion of agglomerated molecules, retaining during their motion their agglomerated condition. The only non-molecular changes which matter in the latter condition is known to undergo, are change of position and change of form. In change of position all the parts of a body move in the same direction; in change of form some, or all of the parts of a body, which are then to be regarded as separate bodies, change their position; therefore as change of position is the definition of motion, we have all change which masses undergo as masses, reduced to motion.

In considering molecular motions, I will select heat as a type of all motions of the class. With regard to heat the opinions of the mass of physicists have within a short time undergone a complete revolution. From having been considered an imponderable form of matter, it came to be considered as force, and lastly as a mode of molecular motion. I think I do not make a mistake in assuming that the last mentioned opinion is the one most generally entertained by physicists at the present time. I will quote from Grove.

"Let us now divest the mind of the impression that heat is in itself any thing substantive, and suppose that these phenomena are regarded for the first time, and without any preconceived notion on the subject; let us introduce no hypothesis, but merely express the facts of which we have become cognizant; to what do they amount? to this, that matter has pertaining to it a molecular repulsive power, a power of dilatation, *which is communicable by contiguity or proximity*.

Heat, thus viewed, is motion, and this molecular motion we may readily change into motion of masses, or motion in its most ordinary and palpable form; for example, in the steam engine, the piston and all its concomitant masses of matter are moved by the molecular dilatation of the vapor of water." The same view is adopted by Tyndall, who has made it the subject of a course of lectures, in which accu-

racy of definition, force of argument, ingenuity in experiment, and close analysis, are exhibited to a degree, unsurpassed in the literature of science. Helmholtz says: it is "a peculiar shivering motion of the ultimate particles of bodies." The arguments sustaining this view of heat are to be found in the writings of the great investigators I have named, and I will not here review them, but considering it as admitted that heat is motion of the ultimate particles of masses, consider briefly other modes of molecular motion.

The same reasoning that has led to the doctrine that heat is motion, has established the doctrine that all the radiant forces, so called, are modes of molecular motion. Youmans says: "these forces have passed through their material stage, and are now to be regarded as kindred and convertible modes of motion." We now have all the changes which matter undergoes reduced to motions of the particles which compose it, or the mass as a whole, or of portions of it in different directions; and if the arguments which sustain this doctrine are sound, the general proposition, that all motion is change and all change is motion, follows, I think, as a logical sequence. The desire not to extend this paper has induced me to omit a synopsis of these arguments which are well known to students of physical science. They are advocated by the first thinkers of the present time, and the opinions they sustain were also although not fully, entertained by Locke, Newton, Bacon, and other great lights of the past. To me they are satisfactory, and will, I think, endure the test of future experiment and discovery.

But agreeing as I do with the theories to which I have referred, I am forced to differ in some important particulars, from those who originated, and who advocate them. Nearly all of the physicists of the present day, while admitting that what have been considered as forces in former times are now to be considered as motions, refer them to some occult or hidden force as their cause, inherent in matter and inseparable from it, immaterial and

indestructible in its nature, convertible into various forms and only acting upon the concurrence of certain conditions.

It seems to me that in speaking of these motions, the application to them of the general term force, becomes, in the present state of science, a positive impediment to advancement. It is the domain of physics to seek to ascertain the conditions under which matter moves, or in other words undergoes change. All that can be predicated of matter is, that it moves. Motion is doubtless an inseparable and probably an essential attribute of matter. To say that it is moved, except by moving matter is, I think, to assert that which is not susceptible of proof; besides, when we attempt to step beyond matter we enter the realm of metaphysics, and to attempt to answer the question, Why does matter move? would be to plunge into the depths of transcendental philosophy beyond the limit of human thought, I therefore venture to assert that it is as foreign to natural science, to attempt to discover why matter moves, as to discover why matter is. That matter exists and moves is, I think, the extreme limit to which the mind of man can reach. In the light of the doctrine that all the so called forces are motions of matter, there is no other force than *moving matter*, and the term force as implying something occult, should be discarded altogether. Grove defines force as "that which produces or resists motion, and also that active principle inseparable from matter which is supposed to induce its various changes. He admits that the term is valueless except as a convenience to expression, that we know nothing of the "*modus agendi* of matter," and that the term force does not help us to understand it. It seems to me that the word cause is a much better term, and that the proposition *that the cause of all motion or change* of matter, is an antecedent change or changes of other matter is incontrovertible. Conditions only are causes. As all matter moves incessantly, the only change which it can possibly undergo, is a change of motion, it never can reach a state of absolute rest. This

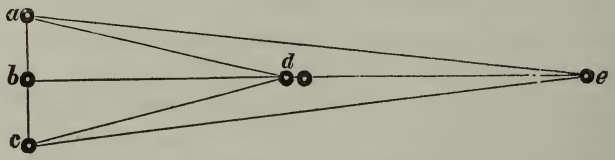
change of motion is itself motion, and the antecedent conditions which are the cause of this change, are matter and change of that matter. In other words, when a change takes place, another change supervenes, itself an antecedent condition of another change, and so on forever.

In order that matter may move in any particular manner, a corresponding opposite change must take place in other matter; that is, if one body moves more, some other body must move less. All of the aggerose motions of a body may perhaps be theoretically imparted to another body in this way, but we can adduce no instance of their being thus imparted. If we should project a perfectly elastic body in the plane of the earth's equator in the direction of the earth's rotation, it would possess two motions; the one imparted to it by projection, the other by the earth's rotation. Now, if it should approach sufficiently near another elastic body, at rest with regard to the earth's rotary motion, it would impart all the motion it retained from its projection, while its motion derived from the earth's rotation would remain undiminished. If a similar body should be projected in an opposite direction it might be considered as possessing two motions, one in the direction of the earth's rotation, and another derived from its projection in an opposite direction. Should it approach sufficiently near another body it would impart motion to it, but only that which it retained from its projection, while it would as before, retain all the motion acquired from the earth's rotation. The true doctrine with regard to the imparting of motion, appears to me to be this, that as no body possesses, so far as we can discern, a solitary motion, and as the conditions for the imparting of these motions differ with the motions themselves, and as these conditions oppose each other, it is practically impossible that all of the motions which belong to any particular mass of matter, should be imparted to another mass. Suppose a body to be dropped from an elevation toward the earth. From the time it is let fall, until some

other change transpires, it has the following motions; a motion toward the earth's center of gravity; a motion in the direction of the earth's rotation; a motion corresponding to the motion of the Poles of the earth called nutation; a motion around the center of gravity of the earth and the moon taken together; a motion around the center of gravity of the earth and the sun taken together; a motion around the sun with the earth in its annual revolution; a motion around the center of the great nebula of which the solar system is only, so to speak, an atom; and without doubt, many other motions, of which we are totally unconscious, and which we may never detect by experiment or induction. Now one of the conditions which are necessary in order that a body may impart the whole of any particular motion to another body, is, that the direction of the motion which is to be imparted, shall be in a right line joining the centers of the two bodies. All motions in curves are to be regarded as resultants. All the so called radiant forces act in lines radiating from some point within a mass of matter, which point may be considered as the center of that particular mode of motion. With regard to gravity heat, light, &c., this manner of action causes a remarkable variation in the amount of motion imparted at different distances from the center of either of these motions, the amount varying inversely as the squares of the distances from their centers. This is of course a necessary consequence of such a mode of action; to give a reason for the variation in the quantity imparted, would be to give a reason why motion is thus imparted from a center; or what is the same thing, to show why the resultant of the motions of the particles of a mass, is a motion in a right line to or from its center of motion. Of course it will remain impossible to demonstrate this until the peculiar nature of these molecular motions shall have been discovered. It may indeed be possible to determine something of their nature from the two data already established, and to which I have alluded viz., that motion is imparted in right lines

joining the centers of masses, and that it is imparted, as these centers approach, according to the law above enunciated. I cannot believe that the motion of gravity is the result of a single so-called force acting in right lines between the centers of bodies, from the fact that it is affected by distance, according to the law referred to ; for agreeing with Prof. Faraday, "that there is no apparent reason why a force acting upon two atoms of matter at a distance from each other, should vary as the distance is increased or diminished," and that such a theory conflicts with "*the highest law in physical science which our faculties permit us to perceive — the conservation of force*," it appears plain to me that in an aglomerated condition, the result of such attraction, by a constant unvarying force, would be motion increased by distance and not decreased.

In the following figure suppose *a*, *b*, *c*, *d*, and *e*, to be particles possessing such an attractive force not variable; suppose further the particle *b* in the figure to



be placed at an equal distance from two other equal particles *a*, *c*, and in a line joining their centers; it would move toward neither; its motion therefore would be *o*. Now if another particle *d*, be placed at a distance from *b*, and in such a position that a line joining the centers of *b* and *d*, should bisect the angle included by the lines joining the centers *a* and *d*, and of *c* and *d*, *d* would move toward *b*, but the force which *a* exerts upon *d*, and the force which *c* exerts upon *d*, act against each other, while *b* exerts its force directly upon *d*. Now if *d* should be removed to *e*, the forces respectively exerted by *a* and *b* would act in lines more nearly parallel to each other, and the motion produced by them should be increased and not diminished.

The fact that a spring at a distance from the earth would be less compressed by the weight of a body, than near to it, only proves that that there is less motion imparted to the body as it is removed from the earth's center, for I regard the so called force of tension only as increased molecular motion in a particular direction. The statement that gravity is a force decreasing inversely as the square of the distance increases, seems to me to convey utterly erroneous ideas as to gravity, and to stand as a stumbling block in the path of advancement. The fact that a body moves less at a distance from the earth when free to move, proves only that less motion is imparted to it; it does not prove that the force, if there be an occult force, which produces that motion, is less, it shows only that less of it is expended in producing that particular motion; and that a body weighs less, is only to say that it moves less, since weight is the measure of the earth's attraction, or in other words, the measure of the motion which is induced in bodies at a distance from its center. How would it be possible to demonstrate by experiment that a body weighs less at a greater, than at a less distance from the earth's center? The balance would not avail, for when equal weights are used, the motion would be transferred to the final support, and converted into so called tension, which has already been glanced at. An instrument calculated to measure this tension would then become necessary, and as this instrument, if the views I have already advanced with regard to this "mode of motion" be correct, can only show how much motion has been transferred to it, we therefore can only say, that at a distance from the earth, a body left free to move, would move less than it would move, if nearer to the earth's center, and if this and this only is meant by the expression, the attraction varies as the squares of the distances from the centers of attracting bodies, I make no objection to the term thus freed from the vague idea of occult varying force. All anal-

ogy leads us to believe, that, as before enunciated, if a body near to the earth moves more than at a distance from it, some other matter or body of matter must move less, and thus the great doctrine of the conservation of force is not affected.

This doctrine of the conservation of force is, I believe, accepted by the leading naturalists of the present day almost universally. But if it be true that all the so called forces of which we are cognizant, are to be considered as modes of motion, the term, conservation of force, should be altered to suit this view, and the term, so altered to conservation of motion, would inevitably and logically lead us to these propositions: First, the amount of motion throughout the entire universe is constant for all times, and for any particular period of time; and, secondly, when any particular motion ceases, partially or entirely, some equal amount of motion takes place simultaneously. In other words, the cessation of any particular motion of matter is either a proximate or a remote cause of motion in other matter. I do not propose to discuss the question of the simultaneity of cause and effect, although, of course, this has a most important bearing upon he doctrine of the conservation of motion; but I will simply remark in passing, that the theory of the conservation of motion, so far as material causes and effects are concerned, throws a clear light upon this much debated question, and completely confutes the old dogma of the logicians: "*Cessante causa cessat et affectus;*" for a motion which takes place upon the cessation of another motion, will continue until itself becomes the cause of still another motion, a fact now admitted by all, except in those cases in which the motion seems to disappear; as in the case of bodies coming to rest upon the earth's surface after falling, or the arresting the fall of a body by the tension of a spring or cord.

To account for the supposed suspension of motion in such cases, the idea of an occult force or power, existing in

an inactive state and requiring certain conditions to arouse it into action very naturally obtained. This latent force was called *vis mortua*, an expression, it seems to me, the most absurd that ever crept into the terminology of science; a term which conveys the idea of an incomplete cause. "A cause of a phenomena," says Mill," is the antecedent, or the concurrence of antecedents, upon which it is invariably and unconditionally consequent:" yet in the term *vis mortua*, we have the notion of force, (defined by Mayer to be cause, and to which he says we should fully apply the principle, "*causa equat effectum*)," which is not a force, and which can not become a force or cause, until some other condition occurs. The term *vis viva* as implying its opposite *vis mortua*, is equally objectionable, and yet Mayer and others make use of this term, and in such a way as to imply the idea of a force, once inert, restored to activity. He says, "the *vis viva* of the universe is a constant quantity." In another place he says, "the attribute of every force is the union of indestructibility with convertibility;" 'in another place, "motion cannot be annihilated." Now what becomes of motion, when *vis viva* is expended, and *vis mortua*, or as he styles it, pushing force, supervenes? For he also asserts that mere pushing force never produces motion. The conversion of falling force into heat will not account for the cessation of the aggerose motion of a body, when its motion is arrested by an elastic spring, for in this case heat motion does not appear. All these difficulties disappear if we adopt the view that the supposed locked up force is molecular motion. A ball laid gently upon the earth induces that mode of molecular motion which is called tension, a term which I consider as conveying the same notion as compression or extension, according to the way in which the motion, is communiated. If a ball falls rapidly to the earth, upon the sudden cessation of its mass motion, both heat motion and tension take place, and these two motions, provided no other motion takes place, will equal the entire motion of the mass, previous to the change which takes place upon its

reaching the earth. The tension remains unaltered until some other change takes place; the heat induces motion in surrounding bodies and thus is merged into other modes of motion, and so on, *ad infinitum*.

Another term which is the offspring of erroneous notions of motion and force, and which, I think, now seriously retards the attainment of correct ideas upon this subject, is inertia.

I object to this term, because if it can be proper to consider it as a property of matter at all, it is only a negative. There would certainly be no end to the properties of matter, if we should adopt the rule of calling negatives properties. I might say of snow that it has the property of not being black, of not being amorphous, and so forth, but I should really not predicate any thing of snow by saying this, and if in addition to this illogical language, it could be proved that snow was really matter in an amorphous condition, and that it was black, or if it yet remained to be proved that such was not the case, the assertion would not only be illogical, and thus calculated to mislead the mind in thinking upon the subject snow, but would also be either false or hypothetical. The idea conveyed by the term inertia, is the want of power in matter to move when at rest, or to come to rest when in motion. Silliman says:— "In consequence of inertia of matter if a moving body should meet no resistance, it would continue to move forever with the same velocity and in the same direction." This idea would be correctly conveyed by saying that moving matter retains its motion, until some change affecting the motion takes place, subsequent to the conditions which were the cause of its motion. On the contrary it is asserted, that a body at rest will remain at rest unless acted upon by some external force. Here something is predicated of matter as existing in a state of which we know absolutely nothing, rest; and in which state, we have every reason to believe, it does not exist in the entire universe. Matter in a state of rest

would, in my opinion, so far as our knowledge of its existence is concerned, cease to exist; that is, we could know nothing of its existence. With the greatest deference to Prof. Faraday's genius and learning, I must think him wrong when he says, "inertia is probably the best proof of the existence of matter;" it is only through motion that we get any knowledge of its existence. For all the known properties of matter as, color, ponderability, &c., depend upon certain so called forces, which, if the views I have advanced are correct, are all modes of motion. These notions of the inertia of matter have all, undoubtedly, grown out of the idea, that matter resists motion. If a rope attached to a canal-boat should be strongly pulled, the boat would not move at once, but there would nevertheless be motion, and this motion would exist as tension; this tension would finally be converted into aggerose motion, and the boat would then move for a time, if the rope were entirely detached from it. Phenomena like this have led to the belief that matter resists motion, but nothing can be more erroneous. When we say that matter resists motion, we assert that which is not sustained either by fact or induction. The fact that matter apparently moves, under certain conditions, only after a lapse of some time from the application of the moving power, has led to the notion that there is some property of matter in general, which keeps it from moving, and logically to the further belief, that the inertia of bodies is directly as their mass; but there are instances, in which bodies move, on the instant the conditions are established for such motion, as in the case of bodies acted upon by gravity alone; and I believe this will be found to be true in all cases, when the moving power is applied to all the particles of a mass simultaneously; and in which the apparently suspended motion cannot be accounted for by tension or some other mode of motion. The analogies are all in favor of the doctrine that matter tends constantly to move, and never approaches a state of rest, or loses any of its motion, unless an equal increase

of motion appears in other matter. There is, then, no such property in matter as tendency to remain at rest. No man ever perceived matter in that state. The term inertia, as implying something which is at best negative and hypothetical, should be discarded; and if the term is to be used as meaning the tendency of motion to continue, it is certainly a most unfortunate selection of a name for that property. It would be easy to fix upon a term which would convey the idea of the perpetuity of motion, but it is not my province to do this.

And here I cannot forbear noticing a theory which has for its foundation the law of Carnot, and which I think was first put forth by William Thompson, and since assented to by Helmholtz, who states the law in the following general terms: "Only when heat passes from a warmer to a colder body, and then only partially can it be converted into mechanical work. I cannot give this theory in a more condensed form than it is given by Helmholtz, in the words which follow. "At each motion of a terrestrial body," a portion of mechanical force passes by friction or collision into heat, of which only a part can be converted back again into mechanical force. This is also generally the case in every electrical and chemical process. From this it follows that the first portion of the store of force, the unchangeable heat, is augmented by every natural process, while the second portion, mechanical, electrical, and chemical force, must be diminished; so that if the universe be delivered over to the undisturbed action of its physical processes, all force will finally pass into the form of heat, and all heat come into a state of equilibrium. Then all possibility of a further change would be at an end, and the complete cessation of all natural processes must set in. The life of men, animals, and plants, could not of course continue if the sun had lost its high temperature and with it his light, if all the components of the earth's surface had closed those combinations which their affinities

demand. In short, the universe from that time forward would be condemned to a state of eternal rest."

This theory is remarkable in that it is thus indorsed by one of the strongest advocates of the conservation of force, and is a striking example of the way in which thought may be shackled by language. Considering force as an occult property of matter, and overlooking the fact, that in the state of equilibrium to which all forces converted into heat must finally come, these forces having ceased to exist, heat itself, considered as a force, must have also ceased to exist, as otherwise we should have a cause without an effect, he reaches this impossible state of all matter, absolute rest, involving the idea of cessation of motion in matter without a coresponding increase of motion in other matter; besides it does not follow, that because heat cannot be converted wholly into mechanical work, that it cannot be converted into other modes of motion, which in their term shall be again converted into heat. I am also at a loss to see how this state of absolute rest is compatible with the definition of heat as given by the same writer, "a shivering motion of the ultimate particles of bodies."

The terms *action* and *reaction* also, in their accepted meaning, are faulty, conveying a wrong idea of the rationale of motion. Bodies are never moved by the direct contact of their surfaces. I need not dwell upon the foundation for the doctrine that the ultimate particles of matter never touch each other. But I will give as an additional argument in favor of this doctrine what I have never yet seen or heard propounded as sustaining it, viz., the fact, that matter, in all the states in which it is known to exist, admits of the artificial separation of its parts. Whatever may be the cause of the variation in attraction which I have before noticed, viz., that the tendency of bodies to approach each other varies as the square of the distance between the centers of attraction, the conclusion seems inevitable that did the molecules of matter ever come into actua contact they would cohere with such force as to be insepar-

able by artificial means. The fact that they can be thus separated, taken in connection with this well established law of attraction, is conclusive to my mind that they do never come into direct contact. Now, when the terms action and reaction are used, what idea is desired to be conveyed? Two bodies approach each other, and when they have reached a certain point of approximation, they coincidently recede; this is the phenomena to which we desire to give a name. Do these co-relative terms action and reaction properly connote the facts? They, too, are the offshoots of wrong notions of motion and force, and, I think, stand directly in the path of advancement. It is from the objectional mode of viewing the several phenomena which it is sought to characterize by them, that the theory of media as being necessary to the propagation of force, has been derived. This theory I am well aware is not to berashly opposed, advocated as it is so universally, and by such thinkers as Newton and others no less profound. Yet I cannot but dissent from it and I do so in the following general terms. No medium is essential for the transmission of motion.

To supply a medium for the propagation of force the hypothesis of an all-permeating imponderable ether has been called in, which, like the idea of occult force, has stood prominently forth in the teachings of philosophers of past and present times. The tendency of the present age is, undoubtedly, to discard such hypotheses, and to view all physical phenomena as material manifestations; so that while the doctrine of a medium, as essential to the transmission of motion, is still adhered to, the medium is supposed to be ordinary matter in a state of extreme tenuity, yet possessing the essential attributes of matter as ponderability, extension and so forth, the undulation of which transmits motion to bodies remote from the sources of motion. Thus light heat, &c., are supposed to be transmitted.

Now if the interplanetary matter be, as Grove and

others maintain, "ordinary matter," and yet so attenuated as to manifest in an "indefinitely small degree, the most ordinary properties of matter," and the dense parts are in a great degree the conveyors of these undulations, it follows, that as the density of this medium must vary greatly in different parts of the interplanetary regions, all calculations of distance, founded upon astronomical observations, depending upon the transmission of light through so unequally dense a medium, must be liable to error; and it is scarcely possible, that this would not have been discovered, during the long series of observations which have been made by observers who would not be likely to overlook any source of inaccuracy.

The theory of an imponderable, all-permeating, and equally dense medium is a hypothesis, reaching beyond matter, and as such is not properly a subject for physical investigation. It is only an attempt to answer, that, to human understanding, unanswerable question, why matter moves.

What appears to be the main argument against the theory of a medium composed of ordinary matter in an attenuated condition, is, that no medium is required for transmission of motion though molecular intervals. Otherwise we suppose that in certain states of matter the ultimate particles actually touch each other, and that matter in this peculiar condition actually touches other matter, which the known law of attraction seems to refute. If this reasoning is not faulty, and the fact be admitted that motion can be transmitted through small intervals, there certainly can be no difficulty in supposing the same to be the case through larger intervals, and analogy would certainly lead us to that belief.

Finally, I fail to see why it is better philosophy to assume intermediate force between motion and the "First Cause," of all things, than to suppose no force between matter and that cause; or why it is better to suppose one force than many. It is, I think, an unnecessary hypothesis leading to

error in thought and conclusion. To admit that there is a limit to human thought and understanding, and if possible to define that limit, would be of incalculable benefit to mankind, serving to check those vain speculations, upon hypothetical abstractions, which have so consumed the time and energies of men in all ages. That in physical science this extreme limit is reached in the conclusion that matter *is*, and that matter *moves*. I firmly believe. Whatever we learn of what lies beyond this, must be through revelation from a higher intelligence; and where our reason fails to perceive the mysterious link which connects the material with the immaterial, our faith must be to us "the evidence of things not seen."

ART. VII. — *Notices of Peter Penet, and of his Operations among the Oneida Indians; including a Plan prepared by him for the Government of that Tribe.* By FRANKLIN B. HOUGH.

[Read before the Albany Institute January 23, 1866.]

The history of our Indian tribes is diversified by many plans and projects, in which schemes, of ambition and profit, were disguised under the plausible appearance of measures for the public good. The ignorance and credulity of the aboriginal race, vain of personal ornament, easily won by presents, and grateful for favors, presented an inviting opportunity for crafty and selfish men. The early and earnest competition of the French and English colonists, for the trade and friendship of the natives of North America, should have made them quite familiar with these artifices, yet we find long afterwards, and among a tribe that had for nearly two centuries been familiar with Europeans, a successful attempt at imposition by a plausible stranger, for purposes of gain or ambition. This project has been but slightly noticed by historians and never fully presented. We refer to the schemes of Peter Penet, a Frenchman, among the Oneidas, soon after the close of the revolution, and purpose to present in a connected form, the scattered items of his memoirs furnished by the public records, and such details of his operations at Oneida, as we have been able to collect. His *Plan of the Government for the Oneidas*, is now here first presented in book form, and will repay a careful perusal, by those interested in our local history and aboriginal annals.

This personage has left but few materials for his biogra-

phy and these chiefly indicate the career of a speculator and an adventurer, of great personal vanity, with a sharp eye for profits, and a conscience unscrupulous in the attainment of his objects. He appears to have won over to his confidence the sachems of the Oneidas, but never received the support of more than a part of the tribe, and from the nature of his pretensions, at once excited the opposition of the state government from the moment that the character and tendency of his operations became known.

Peter Penet, a merchant of Nantes, France, appears to have first arrived in America, on the 10th of December 1775. He landed at Providence, R. I., in a vessel of Capt. Rhodes, who had been sent to the West Indies for powder. Penet and his partner De Plairne, came from Cape François, having letters and credentials of character, and proposed to undertake to supply arms and munitions to the colonies or to congress, through their business connections in France.

Governor Cooke, of Rhode Island, received them favorably, and gave a letter of introduction to General Washington, then at Cambridge.[1] They immediately repaired to head quarters, and were very courteously received by the commander-in-chief, who cautiously referred them to congress, without committing himself to any endorsement of their plans. Their reception was however quite flattering, and they were sent at the public expense to confer with congress then in session at Philadelphia. General Washington also gave them letters to Governor Trumbull of Connecticut, requesting that carriages might be provided for forwarding them to their destination.[2]

Governor Trumbull examined their proposals, and added his own approval.[3] They left New Haven on the

[1] *American Archives*, IV Series, iv, 235.

[2] *Ib.* 261, 264.

[3] *Ib.* 447.

24th December, and repaired to congress, who approved of their plan, and the secret committee executed a contract with Messrs De Plairne, Penet and Co., for the supply of a large amount of arms from France. From the correspondence of that period, it appears, that they made separate proposals to New York, Virginia and other colonies for the sale of cannon, ordnance stores and small arms, and that among the orders received, was one from Virginia, for twelve six pounder cannon.[1] We have not met with this contract, made with the secret committee of congress, and only learn incidentally, that it involved the shipment of tobacco in payment direct to France,[2] the customary mode of exportation having formerly been by way of England.

This arrangement having been completed, Mr. Penet left America in March 1776, in a vessel hired on purpose for sending him and another of his countrymen to France.[3] Mr. Penet was entrusted with letters to our agents abroad, and coming directly from the scene of action that was then exciting great interest in Europe, was able to give information and details of value to the colonial cause. Yet he returned from Philadelphia empty handed, and it required diplomacy of no ordinary ability to meet the emergencies that arose in attempting to fulfil his contract. M. Dubourg, in writing to Dr. Franklin in June 1776, says: "Mr. Penet appears a faithful, active, intelligent man, and very much the connoisseur in arms of every kind; but I have been led to think, that your committee not knowing him sufficiently to trust with large pecuniary funds, would only engage themselves to repay amply his advances, and he is not in condition to do great things in that way, however good his disposition is therefor. This is what retards all the operations, which might have been much accele-

[1] *American Archives*, IV Series, vi., 781.
[2] *Ib.* IV Series, vi, 447.
[3] *Ib.* 660.

rated if you had somebody here duly authorized to make bargains, and to pass engagements in the name of the Thirteen United Colonies, on terms which would be readily owned agreeable."[1]

He was first received with that caution due to a stranger in a delicate negociation, where the action and intentions of the French government were as yet concealed under an assumed reserve, yet when M. Dubourg assured him of the favorable wishes of the court and nation in behalf of the colonies, he saw upon his countenance such a natural diffusion of joy, as completely determined him that he might confide in him.[2]

Penet was recalled from Nantes to be secretly presented to the minister of foreign affairs, for consultation upon the condition, resources and prospects of the colonies, and he managed to procure and forward a considerable amount of arms under his contract.[3] The following letter to General Washington, indicates the progress of these negociations:[4]

NANTES, August 3, 1776.

"My GENERAL: I am pleased to present you my respects, and to inform you of the success of my operations in France; I can assure you, you need not fear the want of ammunition. I have found the means to furnish your armies, and to provide your garrisons. There will go to you immediately four subjects, two of which are of distinction and great merit, and who will deliver into proper hands, the political state of France, England, Spain and Portugal. We wish every success to your armies, and also if possible, that we may lend a hand. The letter which will be sent to you by one of these gentlemen, will inform you well of interesting and advantageous circumstances, which I cannot communicate to you but by them. I have, my General,

[1] *American Archives* IV Series, vi, 779.

[2] *Ib.* 771.

[3] Sparks's *Washington*, iv, 145.

[4] *Diplomatic Correspondence*, i, 11.

a demand to make of you for a favor, which I desire to obtain, and which I hope to merit. I have wrote concerning it to Dr. Franklin. It is, that you would grant me the honor of the title of your first aid-de-camp, and that you will permit me to wear the uniform and also the ribbon. I ask no pay but the honor only of being in your service, I hope you will grant me that favor, in consideration of my attachment, and the desire I have to serve with fidelity, the nation of the Thirteen United Colonies of North America. I shall make my residence at Nantes, and don't intend to return to the continent before the end of the war, my presence being necessary for your operations, and not being able to trust such secret affairs but to myself. If I can be so happy as to be of any service to you, I am entirely at your disposal. Dr. Franklin can forward your letters to me, and also the brevet of aid-de-camp, which I hope you will not refuse me, and which I shall receive with the greatest pleasure.

I beg my best respects to Madame Washington, and assure her, that I have the honor to be, my General, her and your most obedient servant.

P. Penet, and Co."[1]

To General Washington.

On the 7th of October, the commander-in-chief addressed the president of congress, enclosing this letter, and asking their leave to grant this request, which was done on the 11th, by a resolution appointing Penet an aid-de-camp by brevet.[2]

It appears that the inquiries of our commissioners in France, did not increase their confidence in Mr Penet's ability to negotiate advantageously, and in their letter to the secret committee of congress, dated Jan 17, 1777, they say:

"We also think it advisable that you should be so far on your guard, with respect to Mons. Penet, as not to deviate

[1] *American Archives*, V Series, ii, 928.

[2] *Ib.* 1398.

from the original contract made with him, as we cannot learn that he is known to be a person of substance: at the same time, it is but justice to say, that he appears to be active, industrious and attentive to your interest. He is, indeed, connected with a very good house in Nantes, M. Gruel, but we do not know the terms of that connection, or how far M. Gruel is answerable. It seems to us that those houses which are connected in Great Britain, are to be avoided."[1]

On the 11th of February, 1777, Arthur Lee wrote to the secret committee of Congress: "Upon examination I find your commercial connection here greatly deranged. It appears to have been the first plan of the committee, to place Mons. Schweighauser as a check over Mons. Penet. The established character and credit of the former, were to control the confidence reposed in the latter, who, the committee say, had not such recommendations as they could wish.' For this purpose, the consignments were to be made to Mons. Schweighauser, out of which he was to pay Mons. Penet for such goods as were shipped on your account, after being inspected and approved by the former. This was certainly a wise plan, and a necessary precaution. In my humble judgment, it still continues to be absolutely necessary; but instead of the consignments having been made to Mr. Schweighauser, they have been chiefly addressed directly to Penet; in consequence of this, the latter has not submitted the goods sent to the inspection of the former, and Mr. Schweighauser has reason to complain of his being neglected, after an express promise given him of your consignments, without his being able to conceive in what he has offended. These are facts, which I think it my duty to state to you. Mons. Montanduine and Mons. Schweighauser, are certainly the first in rank and reputation here. It is of more consequence, that merchants of this descrip-

[1] *Diplomatic Correspondence*, i, 252.

tion should be your correspondents here than it is in England, because they have an influence with the government. which those of an inferior order have not. Of this order is Mr. Gruel, and still lower Mr. Penet; but the credit and character of the former are exceedingly well established." [1]

About two years later, we find Mr. Penet petitioning congress for encouragement in the establishment of an armory, and on the 2nd of January 1779, the committee to whom the petition of Messrs Penet and Couloux, proposing to establish a manufactory of fire arms, side arms &c, had been referred, made a favorable report. They proposed to contract for one hundred thousand muskets and bayonets, at twenty six and a half livres each, in specie[2] of which twenty thousand were to be delivered in two and a half years, and the rest in six or seven years. They would also undertake to make any other kind of arms. The board of war was authorized to contract upon these terms, and on the 3d of February, the name of the contracting firm was changed to Penet, Windel & Co.[3]

This arrangement was never carried into effect probably from the inability of Penet to meet his part of the engagement.

Among the commissions received by Penet from the American Colonies, was an order from Pennsylvania for arms, munitions, standards for the use of her troops, and a seal with the state arms engraved. In a letter dated at Nantes, May 20, 1780, apologizing for delay and explaining its causes, he solicits the appointment of state agent, and reminds the governor of a promise made before his departure, that he would make a motion in his behalf in the council, promising that if he could be so happy as to

[1] *Diplomatic Correspondence*, ii, 30.

[2] Equal to $4.93.

[3] *Journal of Congress*, Folwell's Edition p. 4, 31.

obtain that mark of confidence, his conduct should soon evince the utility and propriety of their choice.[1]

Penet is next found operating upon the confidence of the governors of New York[2] and Pennsylvania[3] by offering for sale some new discoveries; a cheap metal for sheathing ships, and a mastic for preserving iron from rust, but in neither instance did he succeed in his negotiation. In the very plausible letters in which he set forth the merits of the new invention, he intimates that they had been tested and approved in the royal navy, and were coming into general use in Holland and France. He states that manufactories had been established and himself appointed sole agent of the company, to export their metal and mastic to America. Of himself he says:

"The reputation of my late partner Mr. Plairne, has, I believe, reached you. I am known in America since the year 1775, when first I carried to Cambridge, gunpowder, arms and other military stores to defend your liberty. I have, from that time, supplied several states with the like articles, besides clothing and accoutrements for your troops. Being concerned in your welfare and independence, I make bold to offer you my humble services. I propose at the same time, to furnish you the metal and varnish on the following terms, etc."

At about this period, Penet was employed by the state of Virginia, to borrow money in France. We have met with no statement of the success of this effort, but learn from a letter of Dr. Franklin, dated on the 14th of December, 1782, its result. He says: "Penet, who was employed by that state, to borrow money here, is broke and absconded. His creditors are all worrying me with their complaints, who have nothing to do with his affairs.

[1] *Pennsylvania Archives*, viii, 257.

[2] *Clinton Papers*, 4,048, Oct. 7, 1780.

[3] *Pennsylvania Archives*, ix, 430, same date as above.

We have put faith in every adventurer, who pretended to have influence here, and who when he arrived, had none but what your appointment gave him."[1]

The next trace we find of this adventurer, is in 1783, when his name appears in the Albany county clerk's records,[2] as a purchaser of "a certain messuage and lot (in his actual possession now being), in the city of Schenectady," which he purchased of John Cuyler, for £1,050, and which from other accounts, appear to have been a dwelling and store. This property was in 1788, still known as the "Penet place," and afterwards passed into the hands of Charles Martin. It was on the north side of State street, one lot west of Church street. There were at one time, two lots owned by Penet adjacent, and with 35 and 45 feet fronts respectively, Amsterdam measure. In these conveyances, Mr. Penet is mentioned as a merchant of Philadelphia.

In 1787, we find him mentioned as a trader with the Oneidas, in their village near Oneida Lake, and among a portion of these people he acquired a great ascendency. Upon the appointment of commissioners by the state of New York, to determine the territorial claims of the Oneidas, in 1788, Mr. John Tayler agent for settling preliminaries, found it expedient to consult with him, and to ask his aid in promoting these measures.[3] Messrs Lebon and Paroche, were then his mercantile agents at Oneida. Mr. Penet was one of the witnesses of the Onondaga treaty signed at Fort Schuyler (now Rome), on the 12th of September, 1788. At the same time and place where this treaty was concluded, the commissioners held a treaty with the Oneidas,[4] whose claims upon the favor of the state, were

[1] Sparks's *Writings of Franklin*, ix, 448.

[2] Deeds, x, 387, Oct. 7, 1783; also Deeds Schenectady, C, 512, June 7, 1788.

[3] *Indian Treaties of New York*, i, 132, 139.

[4] *Ib.* i, 233.

much stronger than those of any other tribe, of the Five Nations, on account of their services in the revolution.

In pointing out the boundaries they wished to have reserved, they at first included all the lands on the north side of Wood creek and the Oneida lake, with a large tract south; but upon further consideration, they agreed to cede all north of the lake and creek, excepting a narrow reservation along its banks, upon condition, "that the commissioners would agree to make a compensation to Mr. Penet out of it, for his benevolence and services to them."

In a speech made by Good Peter, an Oneida orator, he alluded to his friend in the following terms:

"BROTHER[1] GOVERNOR! you know our minds. When our business is completed, and we take leave of each other, whatever we have to say to you, we will always communicate to you through our father the French gentleman, (pointing to Mr. Penet), and we request that you'll make him the channel of communication of whatever you have to say to us. He is a just and righteous man; he will deceive us in nothing, but will declare to us the very truth; had it not been for him, we should have been ruined. We know that you have entered into a firm covenant and alliance with our father the French king, and that you have one heart and one mind, which you have told us often, and now we see it verified."

A string of six rows of black wampum.

"BROTHER, our chief, I now call for your attention, that you will in very deed open your ears and hear our speech. I have already congratulated you with the thanks of all the nation, that you, my brother of New York, with my father, the French, took us hold by the hand, and drew us out of the war, and now you see us settled here in peace.

[1] The Indians in addressing the French, always used the term Father, and when speaking to the English called them Brothers.

"Brother: It is beyond a doubt that the Great Spirit above, put it into the mind of my father, the French, to assist the injured and distressed at this critical moment. You also, my brother, have partaken of the advantages of an alliance with that nation equally with us, the Oneidas, his children.

"As we have nothing to give our father the French gentleman, but our mind and our thanks, by this, (presenting a large belt to Mr. Penet), we express our gratitude and return him the thanks of our nation.

"Suffer me now to express our wish to both of you, representing, as I may say, Nations, that you exert yourselves to preserve the friendship and strengthen the alliance between you. I know that you have respectively that power, and that government will bind nations together. I also know, that every nation throughout the world, is liable to changes and subversion, and it is possible, that at some future period, the Evil Spirit may destroy this connection between you. It requires, therefore, your utmost circumspection to preserve it." [1]

In consequence of this stipulation, the Oneida treaty of September 22, 1788, was made to embrace the following article:

* * * * * "And further, that the people of the State of New York, shall, as a benevolence from the Oneidas to Peter Penet, and in return for services rendered by him to their nation, grant to the said Peter Penet, of the said ceded lands lying to the northward of the Oneida lake, a tract of ten miles square, wherever he shall elect the same." [2]

From the speech of Good Peter we infer, that the pretensions of Penet, as a representative of the king of France, were of the most extravagant kind, and that in the mind of the orator, there was no distinction of rank

[1] *Indian Treaties* of New York, i, 235, 236.

[2] *Ib.*, 245.

between him and the governor of New York. The Plan of Government to be hereafter noticed is dated about a month later than the treaty, and was probably then under consideration, although it is not alluded to in the proceedings that attended that negotiation.

In June, 1789, Mr. John Tayler was employed to visit the Indians, and pay the annuities stipulated in the treaty. At Fort Schuyler he met the Oneidas, and Peter, their orator, in a speech on that occasion said:

"BROTHER: We were happy to hear, in the time of the late troubles, that an alliance had been formed between your nation and the great king of France; and from time to time, we heard there would be a lasting union between the two nations, and this alliance would spread its influence over us all in every quarter of America; and in his love for us, he sent over a Great Man (meaning Peter Penet), to take care of our affairs. We have heard several times, since the opening of the spring, that he would soon make his appearance, and the days were named when he would see us in our country; and the Great Man (meaning the ambassador [1]), and our mother, the French lady (meaning the Marchioness [2]), was to accompany him up, and we expected them previously to your meeting us on this ground. Now, brother, we want seriously to enquire of you, if you know any thing of these matters, and what has become of our Father Penet?"

To this inquiry the agent replied, after informing them that each government had an ambassador at the capital of the other, but that they did not meddle with the affairs of the subjects of the others.

"You must see the propriety of this remark; I shall therefore say no more on that head. As to your Father Penet, (as you call him), I can inform you he has no pub-

[1] The Count de Moustier, who was appointed September 17, 1787, to succeed the Chevalier de la Luzerne as minister from France.

[2] The Marchioness de Biron, a sister-in-law of the minister. Both of those persons had attended the Oneida treaty the year previous.

lic commission from the king of France, that his first acquaintance with the ambassador was last summer at Albany: he came into this country as a merchant, and has entered into Indian affairs without any authority, and you may be assured that no transaction of a public nature has yet passed through his hands.

"It is reported at Schenectady that his house is sold, and it is not publicly known where he is gone.

"BROTHERS: The governor at the last treaty, exhorted you to attend to your own affairs, and hoped that you would not be misled by idle and foolish tales, such as might answer to deceive children, but ought not to be credited by men. I wish you would attend to his advice, and keep in the path he placed you."[1]

Thus disconcerted in their assurances, and perplexed by the conflicting statements concerning Penet, twenty Oneidas united in a letter to Governor Clinton of which the following is a copy:

"BROTHER: This is to inform you our situation, that we the three tribes of Oneidas, are divided into two parties, that is to say, the Sachems follow Mr. Peter Penet, the Frenchman's advice; and we the chief warriors and the majority of our nation, even women, follow the State of New York. We therefore make a petition, and enquire you as we look upon you as a true loving brother, and as you the father of the State, &c, &c.

"BROTHER: At the first arrival of Mr. Peter Penet into our castle, he delivered his speech to us (about two years ago), as follows: 'My children, attend: I am appointed by the Great King and the Marquis de la Fayette, as a Deputy Superintendent over some of the tribes of Indians here in America, &c. I am safely arrived here in your castle. The great king of France, and the Marquis de la Fayette long to see you happy. You are now the first nation I entered into, and I see you are happy and glad to see me here, and I must therefore choose your nation to be his subjects, and you must obey what I say to you, because it is

[1] *Indian Treaties*, ii. 320 1

from the Great King, and you must behave yourselves as a people, and for that reason, the westward and all other nations of Indians may come and confederate with you and with us. I come not to defraud you about your lands, (as your brothers the Americans have done already to you these many times), but I am come here to do you good, and make you sensible of what you have already done to yourselves. But if you dont mind what I say to you, your brothers the Americans will take all your lands away in a few days: but if you will obey me you'll flourish and be the happiest people in America.'

"Brother: But now Mr. Penet informs us this spring, that he was sent by the ambassador, who now resides in New York, on that business. Mr. Penet, at the same time, begs of us a piece of land by dream, which was granted, ten miles square north of the Oneida lake, though some of us remember his several speeches, and try to stop our lands, but could not prevail.

"Brother: We therefore beg your Excellency to enquire, that whether this Penet is authorized by the king of France or no, to do public business to the Indians or to the Oneidas only. But if these important affairs are unknown to you, you will be pleased to make enquiry of the ambassador, whether these things are so or not, and if he is appointed by the king, and by the marquis, and then what made him delay coming to us and is unknown to us, and this is what made us to distrust him; and as for the agreement made between us and you, we, the chief warriors, are firmly united to all our transactions, and we are sensible and very well know, that there is one authorized from the king of France to act and transact with the United States—that is the ambassador, and that there is no other ambassador besides him that we know of. And another thing we would let you know, that there is a French priest[1] arrived in this place, and told us he was

[1] Father Perrot. He had gone before 1793.

sent by the ambassador, according to the desire of some of our sachems; which, we are afraid, that our divisions will grow worse and worse, both in temporal and spiritual, for we wish to have but one sort of religion and minister, that is, Mr. Samuel Kirkland. Further, we would let you know, that our sachems have sent a letter to the ambassador in a private manner, refuse to let us know what they say in their letter, but what we write to you we do it at our council fire; therefore, we wish that the ambassador should know that what our sachems write of him is not from the whole nation.

Done in council at our council house of Oneida, this twenty-third day of August, one thousand, seven hundred and eighty-nine."[1]

To this, Governor Clinton replied in a letter, dated New York, September 12th, 1789:

"Brothers: I have received your letter, and I shall now give you an answer. Mr. Penet is only to be considered among you as an adventuring merchant, pursuing his own private interests. He holds no office, nor does he sustain any public character in this country; but he attempts to deceive you, therefore, when he says he is sent by the king of France and the Marquis de la Fayette, to transact business with you, you ought not to listen to his speeches nor pay any regard to his dreams. The king of France is our good friend and ally; he has an ambassador here (whom you saw with me at Fort Stanwix last fall), to transact business and maintain friendship with the United States, but he has nothing to do with any particular State, or the Indians residing within it. You must not, therefore, believe Mr. Penet when he says he is sent among you by the ambassador. I presume the priest now with you, came at the request of Mr. Penet, and his friends. They have a right to worship God in the manner most agreeable to them, but I approve of your determi-

[1] Signed by twenty Oneidas, and witnessed by six Stockbridges and Tuscaroras.—*Indian Treaties*, ii, 346, where the names of the signers are given.

nation to adhere to your old minister, for I fear the preaching of different doctrines among you, will not only serve to perplex and puzzle your understandings, and divisions either with respect to your temporal or spiritual concerns, may prove dangerous to your welfare and prosperity.

"Brothers: I am happy to hear that you are firmly united as to our late agreement, and you may rest assured that it will be faithfully observed on the part of the state. Let me exhort you to sobriety and industry, for it is this alone, by the blessing of the Great Spirit, that you can secure your comfort and happiness.

"I am your Friend and Brother,

"George Clinton."

A few days after, three Oneidas addressed the following letter to the governor:

"Brother: We, your Brothers, the chief warriors, did send a letter a few days ago to your Excellency, wherein we informed you that we, the Oneidas, are divided into two parties, the Sachems and some of the warriors are for the French, that is to say, *Peter Penet*, and we and some of the chief warriors are for the State of New York, and this is now to inform you again, that we, the warriors, are sorry for our situation. We conversed with our sachems yesterday, in order to unite again, but our sachems spoke to us contrary to our opinions; they say they will make us sensible of our error at Mr Penet's return from Jamaica, and can not make up with us at present.

"Brother: We well remember all our agreements and transactions with you, and will hold it as long as we can, this our sachems blame us a good deal about our errors; but we, the warriors, are sensible that our sachems do err in trusting so much to Mr. Penet. Our sachems have granted another piece of land to one of Mr. Penet's men[1]

[1] To John Francis Perache. The tract was two miles square, and in the

near *Canasoraye* about one mile square, besides the five miles [1] granted to Mr. Penet, without our knowledge, which did hurt to our nation good deal; we therefore beg you not to establish, if this French people should come to you in order to have you to confirm their deeds, because it is not for the whole nation and we will not dispose of any of our lands.

"Oneida, September 20, 1789."

[Signed by three Oneidas.]

Attest, JACOB REED, Clk. [2]

The divisions thus excited among the Oneidas continued to disturb them, and a few weeks later, the Christain party, one portion favoring the Rev. Samuel Kirkland and opposed to the French party, as then known, again addressed the governor as follows:

"BROTHER: We received your answer the 16th of this month, dated the 12th of September last, to which we are happy to hear the truth, that Mr. Penet is nothing else but a merchant pursuing his own interest.

"We and our Sachems were all together, and Colonel Louis[3] was present, when your letter was delivered, but could not persuade our Sachems and Louis to make them believe your letter; and though they believed your hand-

Treaty it is declared to be in satisfaction for an injury done to him by one of the Oneidas.

[1] Ten miles.

[2] *Indian Treaties* ii, 352.

[3] Col. Louis Cook, or Atyatoghhongwen, was a St. Regis Chief, who from hatred to the English, took a decided stand in favor of the colonies in the revolution, and led off quite a number of Caughnawaga and St. Regis Indians. He lived with the Oneidas several years, but when tranquility was restored to the northern border he returned to St. Regis. He participated in all the treaties made by the Canada Indians relative to lands in New York, and was employed tne greater part of his life in the public service of his people. In the revolutionary war, he received a commission as Lieutenant Colonel. He again entered the service in the war of 1812-15, at an advanced age, and died of sickness near Buffalo towards the close of the war.—*History of St. Lawrence and Franklin Counties.*

writing, yet they still hold Mr. Penet, that he is sent from the King of France, and Louis is trying to scare us and said, that he would make us sensible in a few days, and would make us sorry because we don't believe Mr. Penet. We are much surprised of his interruption; and further, he says, in the council, that he will make us sleep very fast, so that we cannot wake up again; and we look upon our Sachems, they are still the same as they were in the first of our division or worse, quite contrary to our opinion; and the said Louis blames us much, and said we did send for him from Canada the beginning of the late war, therefore he thought then that we would mind what he would say to us; but we say he is mistaken about that. The Continental Commissioners of Indian affairs did send for him. This said Louis has despised the governor and can't deny it; but when we told him he should not despise the governor, he said he would do so before your excellency, and he added and said to us; 'You had despised Mr. Penet, because you will not believe him, therefore you shall not expect any presents of him at his return, and let Governor Clinton give you presents more than you ever had; you think you are a free people, but I say you are slaves to the State of New York; but if you are free from the State, I myself will make you slaves. Let your minister, Mr. Kirkland, prove that you are free.'

"Brothers: We remember all our transaction of the late treaties; you always tell us that we are free people, and we look on our nation as free people. Can Col. Louis make us slaves, when he is a stranger to us? Can a single nation make a nation slaves? We think it is too impossible, we never [have,] and cannot recollect we ever gave him commission to reign over us as a king.

"Brothers: We are little sensible that we have a little kind of slavery, our neighboring brothers the white people, do not use us very well, our young warriors were among them; when the white people saw our Indians they kill their neighbor's hogs, and told their neighbors that the

Indians did it, and so our people were put to trouble for it. So Brothers, we wish you would stop your people of serving us so.

"Oneida, October, 28, 1789."

[Signed by thirteen Oneidas.]

"Attest Jas. Reed, Clk."

The expected return of Penet with his presents, was never realized by his deluded friends, yet the bitterness between the parties excited by him, long continued to distract the Oneidas, and may be still traced among them.

Mr. Kirkland, the Presbyterian missionary, who had long labored among these people, became the especial subject of hatred among the friends of Penet, who violently assailed his character and services, and even threatened his life. But his prudence and the address of his friends, averted this peril.[1] This feeling soon abated and a reaction followed in his favor.

The French priest who appeared at Oneida, and took up his residence near the lake, claimed to have been sent up by the French ambassador at New York, in pursuance of an application from the Oneidas themselves. At a council held May 29th 1789, a letter from the ambassador was produced, in which he "grounded the mission of the Romish priest to their country, on their application to him by letter, and therefore it enjoined upon them, to receive him kindly, give him a glebe of three hundred acres, clear a field, and build a house." This letter was attributed to Penet or some of his party, and excited the strongest oppositions to the measure. The priest, however, continued to reside some time at the lake, and Mr. Kirkland speaks very bitterly of him and his party, in his correspondence. The letter of Governor Clinton, already quoted, did much to confirm Mr. Kirkland and to weaken his opponents.[2]

[1] Lothrop's *Kife of Kirkland*, 273, 292.

[2] *Ib.* 294.

In 1793, we meet with another reminiscence of Penet, in the journal of some French agents, who were returning from their first visit to the Castorland tract, on the Black river. One of this party was Mark I. Brunel, then a young political exile in America, and who afterwards became illustrious as an engineer in England. These travellers coming to the Oneida village, in the early part of November, were welcomed as Frenchmen, and directed to the house of the venerable Schenando, then seventy-six years of age, who with his aged wife, did their best to extend a hospitable welcome. But the culinary dainties of these kind hearted people, could scarcely be swallowed by their Parisian guests, who managed to complete their repast from some large wooden bowls full of fresh milk.

In the course of the evening, Schenando, having learned that the party had lately returned from the northern wilderness, enquired about the lands which the Oneidas had given to Penet, who had come some years before with some other Frenchmen to settle at Schenectady; he said, that having convened the Indian villages, he made them magnificent promises of an advantageous trade, but that having left America without paying his debts, these lands were sold at ten cents an acre, although the best located in the country. Schenando[1] showed them some property which had belonged to Penet, and lodged them in a bed which he had left.

The ten-miles-square, granted by the Oneidas to Penet, be selected by his agent, John Duncan,[2] a merchant of Schenectady, the sides of the square corresponding with the principal cardinal points, and the north-west corner resting upon the St. Lawrence at French Creek, the site

[1] Schenando died March 11, 1816. His age was then reported at 110 years. There appears to be an error of 11 years somewhere. See *Annals Tryon Co.*, Ed. 1831, p. 28.

[2] Mr. Duncan died aged 69 years, at the Hermitage, three miles south-east of the city of Schenectady, on the 5th of May, 1791. The premises are now owned by Senator Charles Stanford.

of the present village of Clayton, Jefferson county, N. Y. The soil is excellent, although thin in some places, and the harbor one of the best on the river. The square is included in the present towns of Clayton and Orleans, and was of course excepted from the great sale to Macomb in 1791.

The land commissioners ordered a survey of the tract, on the 8th of August, 1789,[1] and a return was made in November of that year.[2] Penet, by an instrument dated January 23, 1789, having made Mr. Duncan his attorney, the latter, on the 19th of November of that year, received a patent for the tract.[3] On the 13th of July, 1790, Duncan conveyed to James Watson and James Greenleaf of New York, for the nominal sum of five shillings.[4]

We cannot here trace the chain of title, by which it was finally confirmed to the actual settlers.[5] The greater part, after diverse trusts and conveyances, came into the hands of the late John La Farge, formerly of Havre, but subsequently a prominent capitalist of New York city.

But for many years after the settlement of the surrounding lands, there was no resident agent, and at length it came to be regarded as the common property of whoever might choose to settle upon it. This belief attracted a large crowd of irresponsible squatters, who cut timber, cleared lands and made potash, without regard for title, other than that given by actual occupation. If to this, we add its proximity to a foreign frontier, the absence of revenue officers, and the facility afforded by the Thousand Islands for a contraband trade with Canada, and we may readily infer that the *Penetters*, as they came to be known, would soon gain an infamous notoriety in the civil courts, and present difficulties of no common magnitude in the quiet assumption of title by those holding the legal right to the soil.

But Mr. La Farge proved equal to the task, and did not

[1] *Land Office Minutes*, ii, 56.
[2] *Land Papers*, xlvii, 109.
[3] *Patents*, xxi, 407.
[4] Not recorded.
[5] See Hough's *Hist. Jefferson Co.*, pp. 40 to 44.

hesitate to employ the legal remedies suited to his need. Although bitterly opposed, calummiated, and threatened he, at length, succeeded in compelling the settlers to acknowledge and respect his title.[1] A man less scrupulous, or less artful, would have certainly failed in this undertaking.

Among the conflicting titles that arose in this litigation, were some derived from Hippolite Penet, a brother of Peter Penet, residing in Andes, Delaware Co., N. Y. but there were never confined.[2]

Of the subsequent history of Penet, we have no authentic data. About 1821, the question of this title came before the legislature, and the attorney general was ordered to examine and report. There were then about three hundred and twenty families who had been induced to locate on the tract, and were interested in this decision. In the report upon this memorial, it is stated that Penet returned to France, and died there. So far as ever appeared in the trials before the courts, he died without heirs, and probably unmarried.

Plan of Government adopted by the Oneida Nation.

[Printed three weeks as an advertisement in the Albany *Gazette*, February 1789.]

Art. 1. To fix the bounds and limits of the sovereignty of the Oneida nation, to let their vacant lands be properly surveyed, laid out into lots and numbered, and have an exact map made of the same:

Art. 2. Two men shall be appointed by the Grand Council, that are known to be men of principle and interest in the nation: they shall be invested with power to act and

[1] *History of Jefferson Co.*, 135, 208., *etc.*

[2] *History of Jefferson Co.*, 210. The final title of Mr. La Farge upon which he chiefly relied, is believed to have rested upon a comptroller's deed on a tax sale, which forever set at rest any doubts that might have been previously entertained concerning it.

transact all business concerning the leasing and dividing the said land or lands into equal shares, to each person and family, and they shall be obliged to render a true and just account of all their proceedings, from time to time, to the National Council.

Art. 3. From the Lines of Property,[1] a certain tract of woodland shall be reserved for the benefit of both parties, to wit: the farmers of the states, and the farmers of the proprietors of the Oneida nation, to prevent any difficulties that may arise on either side.

Art. 4. A tract of land of four miles in breadth, and extending from the Line of Property to the western boundary of the Oneida territory, secured by the treaty of Fort Stanwix, shall be rented out for the sole benefit of the said nation: which said land shall stand for a township forever.

Art. 5. The Oneida territory, (except that which is fixed by treaty), to be rented out must be equally divided into equal shares, to every man, woman and child of the Oneida nation, without any exception. One tract of this said land to remain forever, as a national fund, without any part thereof being alienated: and the revenues, arising from the same, are to defray all public charges that may or shall hereafter accrue. The administration of this said tract, to be ordered and directed by the Chiefs in Council, who shall render a true and just account, twice in every year, to the Grand Assembly of the said nation.

Art. 6. No man, woman or child, of the said Oneida nation, shall have it in his or her power, to sell one foot of land that shall fall to his or her lot or share, except it be to one of their own nation. All other bargains for such land shall be void and of none effect.

[1] This line agreed upon in a treaty with Sir William Johnson, Nov. 5, 1768, commenced on the Tennessee River and ended at Wood Creek. It here extended from the source of the Unadilla river to a point on the creek about seven miles west of Rome.

Art. 7. If any mine or mines, shall be discovered in any part of the Oneida territories, by any inhabitants settling their lands, he or they shall immediately acquaint the Chief of said nation, and he shall take notice of the same. If it proves of value, the Oneida nation shall receive the tenth part of the same. If any salt spring or springs are discovered, or shall be discovered, they must be reserved for the benefit of the nation in general.

Art. 8. The Grand Council of Oneida shall have power to inform the several families of our nation at Niagara, or elsewhere scattered abroad, and, if when we call on them to return to their native place, they shall return with us, they shall be partakers of all our happiness and benefits, and we will be as one in everything to the promoting of our welfare. But, if after one year and one day, they do not mind to return, after being timely warned, they shall not afterwards be benefitted by any of our incomes that shall hereafter arise, by virtue of our lands and tenements; but their rights must be forever confiscated to the use and benefit of us now present.

Art. 9. The Grand Council shall have power, (so soon as the lands are rented out, and the rents drawn in), to pay all debts which are due to every one in the nation. Every one, however, to be paid out of his or her own share of land so rented out.

Art. 10. The Grand Council shall have power to call on the state, to have an act or law passed, that in case any person or persons settling on our lands, shall not comply with their articles of agreement, we may appeal to the first justice of the peace that may be found in any county next to our territory, for rectifying our grievances, be they of what nation soever. The same justice and law shall also take place in this Grand Council, against any man, woman or child, who shall hurt, wrong or defraud any person or persons, inhabiting any of our said hired lands.

Art. 11. The National or Grand Council, shall consist

of nine members: two Chiefs and one Head Warrior of each tribe.[1] The nomination of the nine chiefs shall be by the Great Assembly of the nation. No person to approach in time of business, without being called for by the chiefs of said council. These nine members of the council shall be vested with power to act, and transact all and every business belonging to the nation; and in behalf of the same, shall once in every year, call a General Assembly, in which every person who is eighteen years old can have a hearing; and where every business for that year shall have a hearing.

Art. 12. All children born in the Oneida nation, shall be in subjection to their parents, till they arrive at the age of maturity: boys to twenty-one and girls to eighteen years of age; at which time or age, the father and mother may, if they have anything to bestow, bestow it on them. It shall be equal with the daughter as with the son, without any distinction; and in case a father dies, one third of all that pertained to him, shall be reserved for his widow, so long as she lives; but, when the mother also be dead, the whole to be divided among the children of the deceased.

Art. 13. If any man or woman of said nation die without issue, and has not disposed of his or her lands, or goods, to any friend or adopted friend in his or her lifetime, then all that is found of the deceased, shall be given to the orphans, if any such are to be found—if none, the whole to be distributed to the nation in general, so far as it will extend.

Art. 14. The Grand Council shall also be empowered to choose one man of a sober and honest character, to overlook the children in town, and see that, in general, they behave well to their parents and superiors: as also to have strict look out that no strong liquors, by any merchant or trader, are sold in the castle: and from this

[1] The Bear, the Wolf, and the Tortoise tribes.

Council, he shall have power to break the vessels where such liquor is found, after the first warning; and if any merchant or trader shall attempt the second time, after warned not to sell any rum or any spirituous liquors, all his liquors shall be stove, and his other goods became a public prize.

Art. 15. A regular school to be opened in the English tongue, for the benefit of the Oneida nation. The nation building a house, which shall prove convenient for that purpose, and setting apart a tract of clear land, part for the maintainance of the master and family, and the remainder to be hired out by the said master for his benefit so long as he may continue in the aforesaid service; and then to go to the one who shall succeed him.

Art. 16. At the Grand Council it is also found beneficial that they be provided with one or two surveyors to survey their lands from line to line, and then to lay all out into proper lots, with their numbers, as the maps shall direct, to prevent any trouble or debate that might hereafter arise.

Art. 17. It is also judged necessary that the Grand Council of the Oneida nation, should be furnished with one interpreter of their own; that they always may depend that he declares the truth of all business committed to his charge, to prevent mistakes, and save them from the alarm of false interpreting.

Art. 18. So soon as the revenues of the nation will permit, the Grand Council will, at their discretion, look out six young men, of the age of twelve or thirteen years, that are of quick comprehension, apt to learn, as also of good and honest morals, to travel abroad, perhaps, two to England, two to France, and two to some parts of the neighboring states, or elsewhere, as their inclination may direct them amongst the white people; to learn not only the languages, but to observe their ways and manners, which may and will prove very advantageous to the whole nation, in a few years if rightly attended to.

Art. 19. The national assembly's desire is, that distinct rule, order, submission and obedience be paid to the chiefs of the Grand Council, who shall be fitted with marks of distinction. In consequence of the same it is resolved, that so soon as convenient material can be procured, eighteen proper marks of distinction shall be given for that purpose; three, representing the tribe of the Bear; three, the tribe of the Wolf; and three, the tribe of the Tortoise. The marks of the Chiefs of War are, a green ribbon, striped on the side with red, to be worn on the left side. Nine marks of distinction for the Chiefs of the Councillors, with the mark of an eagle on a red ribbon, to go round the neck, and hang between the breasts. Be it remembered that those chiefs, whether warriors or councilors, who wear this badge, must be men of truth, honor and wisdom, to discharge the great trust of national business now put into their hands; and whether at home, or abroad, when these marks are seen, it will be remembered that they are this Great Council, and great respect will, at all times be shown them.

Art. 20. All things that will be for the national benefit and may hereafter happen to occur, which are not here written, will at all times, by this Great Council, be rectified to the satisfaction of the whole nation.

We, the Sachems, Chiefs and Head Warriors, in behalf of all the Oneida nation, after consideration of our present situation, have desired to establish a regular government, good rules, religion and principles, not only to the advancement of civilization, but also, to assure our friendship and zeal to all our brethren the Americans, as well as their allies the French nation. In consideration whereof, we, the aforesaid nation, have established twenty articles of government, in the presence of the Honorable Peter Penet, Esquire, our true and trusty friend, adopted and chosen Agent forever: to act for us, and for the good and happiness of our nation: which twenty articles of government, we, the Oneida nation, in council assembled, do

hereby assent to, ratify and confirm, and firmly bind ourselves, and all our nations, to hold, comply with, and fulfil the above mentioned articles, and every part of them, for the future happiness of ourselves and our posterity, forever; that we may obtain the character of a sociable and credible nation, and be looked on as such by all the nations of the world. In confirmation whereof, we have signed our names and set our seals, in behalf of our nation; two copies whereof are to be drawn, one for his Excellency the Governor of New York, and the other for the French ambassador, now residing in New York.

Given in the Great House of SCANONDOE, this twenty-fifth day of October, in the year of our Lord one thousand seven hundred and eighty-eight, and of our New Government, the first.

GASHSAWEDA. his x mark.
JEAGHSWOANGALOLIS, *Puligl.* } his x mark.
AGWILENTENGWAS, *Dom Peter.* } his x mark.
JONEAGHSLIESHEU, *Daniel.* } his x mark.
THAACAGEANDAGOYON. his x mark.
ALLOWESTONES, *Blacksmith.* } his x mark.
KEANJAKO, *David.* } his x mark.
KAHIKTATON. his x mark.
SAGOYONTHA. his x mark.
SHONONDOUGH. his x mark.
HANNAH SODALH. her x mark.
SEYONGHNEHALK, *Konwagalet.* } her x mark.
KASHONGHGUEA, *Konwagalet.* } her x mark.
KONONNEAGETE. her x mark.
ODAGHSEGHTE. his x mark.
KANAGHGURAYA. his x mark.
PETER OTSIQUETTE.
THAGHNIYONGO. his x mark.
THONIGWEOGHSOHALTE. his x mark.
JEKCANDYAKKON. his x mark.

OJOSTULATE, *Hanury.* } his x mark.
OTSETOGON. his x mark.
TEYOHAGWANDA. his x mark.
ONEIYANHA, *Beech Tree.* } his x mark.
THAGHNEGHTOLIS, *Hendrick.* } his x mark.
OHONOUGLEGO, *Anthony.* } his x mark.
THAGHTAGWISEA. his x mark.
SHANAGHSAKIGH. his x mark.

Signed and Sealed in presence of
P. PENET.
EDWARD JOHNSTON, Interpreter.
P. CHEVALIER DE GOYON.
JAMES BAUDRON.
VAUMANE de FONCLAIRE.
J. F. LE BON.
Colonel LUE COOK. his x mark.

Witness { ROTGIENHER. / MARGRITTE GUARINDA, *Letheeni.* } her x mark.

These two witnesses, one a young man, and the other a young woman, were called by the Grand Council to our Assembly, to remember this new plan of government, this day ratified, confirmed and finished.

The two men mentioned in the second article, to act and transact the national business, are nominated and appointed by the Great Council of the Oneidas, to wit: COLONEL LUE COOK, and PETER OTSIQUETTE.

Attested, P. PENET, *Agent.*

Art. VIII.—*Water and its Impurities, with Reference to the Supply of Large Towns.* *By* Jacob S. Mosher, M.D.

[Read before the Institute, March 20, 1866.]

A large portion of the earth is covered with water, exposing its surface to the action of the sun and air. Influenced by these great masses to rise in the form of vapor, which from changes in temperature and other causes are again condensed and return to their original position. From whatever part of the earth this vapor rises it is always the same; unaffected by the condition of the water from which it is produced, salt or fresh, it is uniformly of one constitution by the time it is returned from the clouds to the surface.

When thus precipitated as rain it is the nearest approach to pure water that is ever found in nature. It contains a large amount of atmospheric air, besides several well known chemical solids and gases, which are generated in the atmosphere from electrical and other causes. These last are in such small proportions that they may be disregarded; the dissolved air which is rich in oxygen, instead of being deleterious, adds to the value of water in the manifold uses for which that fluid seems designed, making in fact the difference between fresh spring water and the same after it has been boiled. We may therefore consider rain water before it has reached the earth in its fall, as pure for practical purposes.

The amount of rain that falls in the frigid zones is 1.25 feet per annum.

In Asiatic Russia,	13.5 inches.
" United States,	39 "
" Albany, (Average for 24 years),	40.93 "
" Tropical regions of Eastern continent,	79.7 "
" " " Western continent,	113 "

The average for the temperate zone is 3.05 feet, for tropics 8.5 feet.

At Sierra Leone there fell on the 22d and 23d of August, 1828, twenty-six inches. At Cayenne in French Guiana 10 inches has been collected in 10 hours. An acre of water one inch deep is nearly twenty-three thousand gallons, and weighs more than a hundred tons. Most of this water sinks into the soil until stopped by impenetrable clay or rock, along which it passes until it emerges and finds some stream in which it passes back to the ocean.

In the passage of this immense amount of water back to the sea it is liable to become charged with two kinds of impurity, inorganic and organic. I propose to examine briefly the cause of these. The dissolved mineral substances are the greater part of the inorganic.

In leeching through the mineral crust of the earth it dissolves much of the soluble materials that it meets, and carries them down to lower levels so that they ultimately collect in the sea. An examination of river water shows it to contain solid matters dissolved from the soil. The amount contained of course depends largely on the nature of the soil through which it has passed. Thus we find in the gallon of water which contains 70,000 grains:

The water of the Loka river contains,.....	0.05	grains	of solid	matter.
Common rain and spring waters,...4 or 5 to	60	"	"	"
Albany reservoir water,.....4 to	6	"	"	"
Loire river,.....	9.42	"	"	"
The Garonne at Toulouse,.....	9.56	"	"	"
Danube at Vienna,.....	10.15	"	"	"
Rhine at Basle,.....	11.97	"	"	"
Rhone at Lyons,.....	12.88	"	"	"
Thames at Hampton (above London), ...	15.00	"	"	"
Seine at Paris,.....	20.00	"	"	"
Scheldt in Belgium,.....	20.58	"	"	"

These are waters used for supplying cities.

The amounts in some other waters are interesting. The

wells in London contain sometimes 130 or 140 grains to the gallon; the London deep artesian wells average from 50 to 70 grains; the wells at the royal mint 426 feet deep, 28 grains; a well at Southampton 1,360 feet deep, 68 grains. The famous Grenelle well at Paris 1,794 feet deep has 20 grains of saline matter to the gallon. There is a difference in the character of the saline constituents of the deep wells from those in other waters.

The ocean was once fresh water but has become saline from the matter dissolved out of the earlier rocks. Then the rivers which ran to the sea were more impure than now, for the soluble constituents of the land had not been washed by so many leechings of rain water as at this time: — all that was dissolved was carried down to the sea, some of it to remain in solution, rendering sea water a stronger brine, and depositing other solid matters to aid in filling up its bed. This process is still going on. The salt that comes from the Syracuse brine springs is sent to markets in the east and west and north and south but all finds its place ultimately in the sea. Some of our fashionable visitors at Saratoga would be surprised, if they have not considered the matter, to know that all the waters gushing there from the rocks are only rain waters sent up from the ocean to explore the mountains for salts, which when found are to be brought down to the sea. Nor is the amount of solid matters thus carried away at all a small one. I am saved the necessity of estimating for Saratoga by the results arrived at by Professor Ramsay, who has made this calculation for the waters of the thermal springs at Bath which he informs us, "are far from being conspicuous among the European hot springs, for the quantity of mineral matter contained in them in proportion to the water which acts as a solvent. Yet if the sulphates of lime and soda, and the chlorides of sodium and magnesia and other mineral ingredients which they contain were

solidified, they would form in one year a square column 9 feet in diameter and 140 feet high." If we apply this calculation to all mineral springs, as well as rivers loaded with their small but constant amounts throughout their immense volume, we should find, that the process which is carrying mineral matters out of the soil and into the sea is not by any means one producing small effects.

I am not permitted by my time and the amount of space which can be given to this part of the matter, to investigate the fact that besides carrying out the soluble matters, water assists in the chemical decomposition of interior rocks thus bringing them into solution also. I have said that this process of filling up the bed of the ocean is still going on. Besides mineral springs every gallon of river of spring water that has its five or fifty grains of solids carries them from the mountains and plains to be deposited finally in the bed of the ocean. Each season with frost disintegrates new material and fits it for the next year's floods to remove. In our inland oceans the process goes on at a measurable rate. In the great Salt lake where like the ocean, inlets are pouring their streams and no outlet save evaporation removes them and that only lifts the pure water, we find the lakes year by year becoming a stronger brine; in some of them the point of saturation has been reached, and alkaline salts are actually crystallizing on their bottom and along the shore. Still further, in the same locality we find beds of salt filling up the basins of ancient seas; here the work is done; the sun has evaporated pure water from the lake and left its dissolved matter to fall to the bottom, until the evaporation exceeded the supply by rain. This process is going on in the larger inland oceans of the Eastern Continent.

"The sea of Aral is diminishing rapidly. The Caspian sea though it receives through seventy mouths the majestic volume of the Volga the largest river in Europe

as also the Ural and other large streams, decreases instead of increasing in size." According to one visitor there must have been here at some former period, a vast inland sea extending for hundreds of miles.

The Oceanic waters contain about,	2,500	gr. to the gall	or 3½	per cent.
Great Salt lake about,.....	14,000	"	20	"
The Dead sea nearly,.....	20,000	"	26	"

Lake Elton still more.

Thus we find all the variation from $\frac{1}{2}\frac{1}{0}$ of one per cent. solids or one two thousandth of the bulk, and in these more saline bodies the solids are more than one-fourth of the whole.

The Dead sea contains this immense quantity of solid matter, although the Jordan which flows into it carries only a small amount. ALL seas that have no outlet are salt seas, and for this same reason I do not doubt that the one exception to this rule, lake Tchad in Central Africa will prove to be no exception, for more thorough exploration will determine its outlet either upon the surface or under ground.

A word or two might be interesting as to the effects upon health, of these salts in the small quantities that they are met with in most of the waters supplying cities.

There are opportunities furnished to determine this with more accuracy than we often find in other investigations, owing to the constant nature of the water furnished in any locality giving opportunity to observe the effect, if any, which it has upon the health. From such investigation we have positive conclusions.

"The salubrity of districts bears no relation to the "greater or smaller quantity of saline matter in water. If "distilled water could be supplied to a population in "millions of gallons daily, it would be neither agreeable "nor wholesome to the general public."

It has been clearly proved (*M. Boussingault*), that the calcareous (lime) salts of drinking waters, in connection

with those contained in food, aid in the development of the bony skeletons of animals. (*Pelouze et Fremy Traite de Chimie* 1860, tom. 1, 234).

Some calcareous waters such as Carrara water, are usefully employed in medicine (*Brande and Taylor*). The search after non-calcareous water therefore is based on a fallacy. If lime were not freely taken in our daily food, either in solids or liquids, the bones would be destitute of the proper amount of mineral matter for their natural development.

I remark upon this subject with due hesitancy, for a chemical report made during the last year, and which has the sanction of the Board of Water Commissioners, (being published in their annual report,) speaks of the "salts of lime" as the "objectionable" ones.[1]

In all natural phenomena such as these which are for a few minutes before us, some great end is subserved. We are not always able to see the reason but in this case the utility of the change is manifest. Salt is the great antiseptic. In the water as in the air it is nature's scavenger; while impregnated with it, the ocean retains its purity,—instead of becoming a festering pool of organic decay, poisoning the air and the land with its breath,—and the winds which breathe its odors and whip from the top of curling waves the very water itself, carry with them no miasma but rather health and life.

There is one property of water which it seems proper at this time to notice and in this connection. I said in my almost opening remark, that when condensed from vapor under circumstances which were favorable to its greatest purity, it always retained a large proportion of atmospheric air. This property of absorbing gas is due

[1] The same authority decides the Albany water *proven to be healthy* by a qualitative analysis, which determined a half dozen saline constituents and some organic matter — amount not estimated.

to the arrangement of its atoms. There are cavities in which the air is secreted. In these cavities it has the power of secreting a great variety of gases, some more than others. Under a pressure it will take up more of the same gas; this depends upon the property which gases have of being compressed in larger quantities within the same space. The point which is of most interest to us is, that whenever a surface of water is presented to a gas, the latter is absorbed. Now two gases will not be absorbed to any extent unless they have an affinity and go into chemical union with each other, so that water in which one gas is dissolved will reject another unless the first has been displaced.

If water containing one gas be exposed to the action of a second, it lets a portion of the first escape and absorbs a corresponding quantity of the second. In this way a very small quantity of a sparingly soluble gas may expel a large quantity of one more soluble. A familiar example of this fact, consists in taking a glass half full of champagne, and having formed the palm of the hand into a hollow cup, to strike the top of the glass, closing the glass and flattening the hand at the same time. The air above the wine is thus forcibly compressed, and a portion is then absorbed under pressure by the fluid, from which a quantity of carbonic acid is expelled greater than that of the air absorbed, in the proportion of 1060 to 16 (*Kane*).

To apply this to the purification of natural water;—we will suppose that already some gas say sulphuretted hydrogen is dissolved. This exceedingly offensive impurity would be likely to escape detection were it not for the agency of the atmosphere; expose the water to contact with air; the air cannot enter while the other gas is there; it cannot enter at all unless it will dissolve in water, and examining into this, we find that it possesses the properties necessary to displace other gases. When

they begin to be displaced and their foul presence replaced by pure and healthy air they are at once apparent.

Thus we can see that when God made the great rivers, he rolled them down from the mountain to the sea over rough beds that every atom of their contents could be exposed to and filled with air. The brook first foaming along its bed breathes the free air and carries a full burden of it into the river, which constantly spreads its ever changing surface out to the same exposure. And on the ocean winds play over the water so as to insinuate into it as full a supply of air as it can retain. A careful analysis with reference to this action, of the molecular motion which produces waves, is remarkable in showing that were all of the operations of undulation made subservient to this purpose, they would not be better adapted to it.

We shall find that besides the saline impurities which water receives in its way to the sea from the clouds, there are certain other conditions which may result from the incomplete operation of causes already named. We can see that the water which fell condensed from the air has been exposed in its whole passage back to the sea, to the germs of organic life, and if they be developed, to the organic impurities of their decay. All the changes which have taken place have tended to prevent this. Salts which were dissolved if in sufficient amount, and the aeration kept up by constant motion have this tendency, and when it reaches the sea it is subject to the increased saltness and the action of the wind.

Should there be a defect in any of these operations other results follow. Now defects do not occur in nature, but nature it seems never made any provision for large congregations of men to live together. This we find in many things, and in none is it more apparent than in the difficulty which is met with in furnishing the natural requirements for so many, though they be so bountifully supplied to all who live apart.

Whenever water becomes stagnant organic growths spring up. Vegetable at first, but with the decay of this, there is the appearance of animal life. The gases which result from their death and decay are of the most offensive character, and this is the usual order of their appearance. The order may be varied by the acid or alkaline condition of the water, that which is acid producing vegetation, and the alkaline animalcula. These conditions are illustrated in the bad water of this city for the past few years, though they are not peculiar to the water of Albany or of any other place, being common to all waters exposed to such conditions. The same effect may be easily produced if some of the white of an egg is mixed in water in two glasses, and the one made acid and the other alkaline. In a day or two if kept at a proper temperature they will both swarm with life.

I would not however have it inferred that in consequence of this, and unavoidably, a disagreeable condition of the fluid must exist which is irremediable. The results of their decay are beyond doubt, disagreeable gases; but if you turn them out into the field, which is putting them in nature's laboratory, they will soon be deprived of all offensive character. The manner in which this is done is instructive; resulting from the principle to which I have alluded, that air will displace other gases, they are rolled and tumbled along until every particle of fluid has been acted upon by it, and the water is clean.

We have an illustration on a larger scale before us. The water of the Hudson river at Albany is loaded with organic impurities draining from the refuse of nearly seventy-five thousand persons, yet two miles below the city is unobjectionable for drinking, having become purified in that distance.

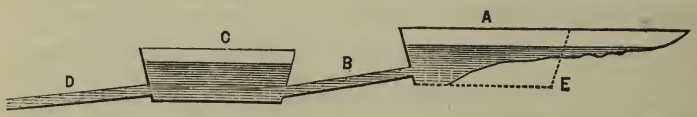
I have thus hastily noticed a few of the facts relating to impurities in waters, confining myself to those which

are of importance in the consideration of the foul character of the waters frequently supplied for the use of cities.

For several years the Albany water has been in the most offensive condition during the summer months, and last August I had the pleasure of being associated with a party visiting the reservoirs for the purpose of seeing if any immediate remedy could be devised. The party consisted of the Water Commissioners, and the Board of Health, and under the guidance of the Superintendent an excellent opportunity was afforded to inspect everything in connection with the Bleecker reservoir, its gate house and surroundings, Rensselaer lake, its banks, supply, outlet, as well as the condition of the water as to temperature, depth, current, and general position with reference to all surrounding matters that might influence it. The result of that expedition was to satisfy all who went, that everything had been done that could be done for keeping the lake and waters clean. The reservoirs were carefully kept, and the neatness of everything in connection with them was observable, showing the judicious system, as well as laborious care that could prevent the collections of slime and filth in places where there was so much tendency to them at that season. No exception is to be made in this remark, for anything in connection with the works that were visited, and it is a matter of gratification to know, that whatever impurity may occur in the water, it is brought to our rooms and table with nothing added by the way. If we take the covering off from the few wells yet remaining in the streets, and examine the pump logs reaching down to the water and the stones that wall up the well with their mosses and slime, we shall be better able to appreciate the watchfulness and labor that prevents the same thing about the city reservoirs, so much more extensive, and subject in summer to a temperature more conducive to this kind of difficulty.

Even the four or five miles of conduit between the lake and the reservoir had been cleaned on the inside through every foot of its extent. Notwithstanding all these precautions the water supplied from this source was affected with an exceedingly offensive taste and smell, that had lasted for some time and remained during most of the season. During a part of the time the odor was that of dead vegetation undergoing decomposition in water, and to this was added at intervals the peculiar smell of dead fish. The water when drawn deposited a reddish brown sediment having the identical appearance of iron rust; if it were permitted to drop for some days on the side of a white bowl, a stain would be produced so similar to that of water containing an excess of iron as to deceive a casual observer; these stains and sediments would have been considered serious impurities, had not their disagreeable effects been entirely overshadowed by the intolerable taste and smell — the offense to the eye was not to be compared with that against the other senses.

There was at the time scarcely any smell to the waters of Rensselaer lake. The same might almost be said of the water in Bleecker reservoir;[1] the following diagram represents the arrangement of these lakes:



A. Rensselaer lake.
B. Conduit from Rensselaer lake to Bleecker reservoir.
C. Bleecker reservoir.
D. Main for supplying the city from Bleecker reservoir.

The marked peculiarity which presented itself in the water of the reservoir became evident if a glass was held

[1] It is proper to state that Mr. Carpenter, after the reading of this paper, differed with me in regard to this fact, his impression being that there was a bad smell in the water at this time. In the city it was so offensive as to

up before the light; numerous floating points could be observed throughout the liquid, which, upon closer inspection under the magnifying power of an ordinary pocket lens, had the appearance of minute threads of glass lying in all directions. Under higher powers of the compound microscope they were resolved into one of the simplest forms of vegetable life, being a simple aggregation of cells, and having the appearance of a number of beads collected in a straight line. Professor Ten Eyck has furnished drawings of them, giving their appearance as seen respectively with a 2 inch lens, and when magnified 200 and 1,000 diameters.

A similar plant was found by Torrey and Chilton, in their examination of Croton water in 1859; Professor Torrey suggests the filaments as being probably derived from the botanical genus Nostoc; his description corresponds with the appearance of those found in the Albany water during the past year.

In Rensselaer lake the water contains the same growth. Scarcely any smell or taste could be observed, and the water in all respects seemed similar to that in the reservoir which derived its supply from it. In both, its condition as to smell and taste was the quality most to be remarked by those who had drawn the same water from the city hydrants that morning.

be nauseating to all the persons in the room if a basin full were drawn, and to wash in it left a smell upon the hands of the most disagreeable character, which was even perceptible to others. There was a slight smell (agreeing with the statement, "scarcely any smell)," and although this may have been more noticeable to one who was accustomed to visit the waters frequently, and closely watch its condition, it was so different from the filthy water drawn from the hydrants that same morning before we left town, as to be a matter of general remark by the gentlemen present. Had it been anything like the water in the city there would not have been any danger of a difference of opinion as to the smell.

Proceeding up to the inlet of Rensselaer lake there was less of the peculiar vegetable growth which I have described, and when one of the creeks that feed the lake was reached, it had almost entirely disappeared.

Such was substantially the state of the water as revealed to us on our excursion to the lake in August 1865, at which time the city supply was in its worst condition.

With occasional variations it has been so for successive summers, during a large part of the time since the water from this source was used, and at times the other lakes have in some degree been affected in like manner. So the next and following seasons may, for a period unpleasantly long, continue the same: and when once free of it there can no period be set for exemption from its return. Every city which is supplied from a source where the amount of water is limited has passed through the same experience that we are now undergoing, and an examination of the reports concerning the water of different places surprises us by the amount of attention that is given to this serious and practical difficulty. None are exempt. London is not too large to be affected by it, and her immense resources have at times seemed powerless for remedy. So with New York — so with Philadelphia — Boston: — and the little village of Cohoes, with the whole Mohawk dashing down its rapids and falls almost through the village itself, takes that same water out from its crystal current in the rocky channel and, imitating the conditions which make the limited supply of other places impure, delivers it into the houses of the place as bad as it is in the largest city which is supplied from a scanty source. In seeking the remedy for such a serious evil we naturally search for the causes which produce it; these are to be found in the properties of natural waters already alluded to, and two methods for the correction of the difficulty are suggested. One is to prevent the formation and growth of organic products in water which is intended for cities — the other method

would be to remove these matters when thus formed before the waters which are contaminated by them are drawn for use.

To apply these two methods to the purification of the waters of Albany will illustrate their application to the water of any other place, and the investigation of the questions which are involved brings us to many interesting facts.

By reference to the diagram (on page 314) it will be seen that the water destined for use in the city is collected in Rensselaer lake which is a large reservoir, and carried from here to the Bleecker whence it is supplied to the city. When it reaches the first of these lakes it is as pure as ordinary spring waters. It has never yet been analysed, but comparative experiments made at various times by different experimenters show that it contains only a small amount of dissolved impurities.

Rensselaer lake contains much shoal water. The part of its bed which is exposed in a drought is much larger than the whole of the deeper portion that remains covered. The shoal places operate in several ways to cause the evil: the heat of the sun falling upon the water reaches the shallow bottom and warms it, and the water is warmed by contact with it; there are no currents, and without motion there is no interchange of the cooler with warmer parts; when dry in summer grasses spring up, which, when submerged by the warm flood, cause a growth of infusoria;[1] to be followed in turn by microscopic vegetal formations.

[1] The flat in this lake which is usually covered with water and was so covered at the time this paper was written, was overgrown by a crop of grass during the dry weather of the ensuing summer (1866) and was mowed. A spear of this, or any similar grass, put in a glass of water and set in the sun in summer would give birth to a flock of infusoria, so named by reason of this. This is the common and well known method of their preparation for microscopic experiments.

The order of growth and decay of the organisms whose death makes the offensive gases, depends upon the relations of animal and vegetable life in the water. First usually there is in stagnant places, the confervoid growth already described which increases with great rapidity and is found largely at the lower part of Rensselaer lake where it is carried by the slight drift of the water towards the conduit. It passes through this into the reservoir (see p. 314), and when carried into the pipes supplying the city, dies; this is probably due to the effect of the iron[1] and as it occurs out of the reach of the atmosphere, aeration is prevented, and the gases resulting from decay are drawn with the water at the hydrants: when these gases are in the water animalcula are again found and the smell of sulphuretted and phosphuretted hydrogen appears. This order of change may be varied by several influences. When the plant is in full growth in the lake, there is a varying amount of it dying from natural causes, and the conditions produced by its decay are unfavorable to the remaining crop which dies rapidly, until the whole mass, buoyed up by adherent

[1] It has been supposed that the plant is killed by the pressure to which it is subjected in these last pipes; this cannot be so for the smell which is the indication of its death, was as offensive, or more so, on the hill where there was not enough pressure to draw it all the time, as it was in any part of the city.

During the discussion, the question arose as to whether all of the plant was killed by the time it was drawn, and it was stated by Prof. Howard Townsend that he had found the plant in microscopic examinations of water which had been drawn from his hydrant in town. This fact is fatal to the theory that the plant is killed by pressure, if the fact already stated is not so; if it were, all would be killed, since all portions are subjected to a pressure that is uniform; if, however, it results from the action of iron, many of the confervoid stems might not meet with sufficient contact during their short passage to cause their destruction.

During the ensuing summer, after reading this paper, the proof of this effect of iron upon this organic matter in the water of Rensselaer lake was experimentally shown to the members of the Institute at one of its meetings.

bubbles of the gases it generates in decay, rises to the top, and with the most offensive smell makes either the islands of rotting vegetation, that observers have found, or is driven ashore by light winds. A heavy wind disturbing the water to any extent would disengage the buoyant bubbles and leave it to fall to the bottom, now in its decay being heavier than the liquid in which it floats.

At this time it partakes of the character of any decomposing material that might be placed in the lake. The action of the air removes the gases almost as soon as formed, and, unless at the mouth of a supply pipe, a supply of water is furnished the city purer than just before. A dead animal thrown in the middle of the lake would no more make the water impure than the organic matters in the river affect its purity, after a short distance. Neither does the excrement of the fish, nor the decay of dead fish; nor, for the same reasons, would the decaying vegetation produce bad tasting or smelling water. The disgusting odors leave the water, and float away in the air, which, at this time, according to the united testimony of all observers who have reported upon it, is in the most intolerable condition. This fetid atmosphere would prove that the purifying of the liquid was going on, if we had not a perfect illustration of it in the river. We find this principle illustrated in many familiar ways. Good coffee cannot be obtained by a process of making, which fills the house with its aroma; all of the many complex contrivances, that have within a few years, become so popular for making coffee which is to retain its flavor, are only so many arrangements for performing the necessary operations, while the volatile oil that gives its flavor is retained in the liquid, instead of being dissipated in the air.

Therefore, it is at these times, when the first growths are rotting in the lake, that the water is comparatively

pure in the city. During the summer there are intermissions in the bad odors, and they *occur at these times.* When it becomes clear in the lake the growth again springs up, and the whole derangement is renewed. The sulphur and phosphorus smells intervene, and become more or less mixed with the other, for the animalcula grow and die with the alternations of gases in the water.

I should like to examine more fully some matters which are suggested by what we have been considering, but the urgency of other duties, and the length of this paper, already longer than was originally intended, forbids. The following conclusions present themselves.

The water would be pure if the organic matters were killed before they entered Bleecker reservoir so that they would assume the character of mechanical impurities in it in a state of decay. This might be done by bringing it through a large number of small iron pipes from one lake to the other. Such a remedy, however interesting in a scientific point of view is not to be considered for a moment as a practical one, for the only practical remedy is to prevent any of the contaminations from occurring.

This will be done when the water is not allowed to become stagnant.

The plan of introducing a larger supply is agitated by the water authorities; a small addition will not be sufficient; it must be enough more to keep a constant current in a lake as large as the Rensselaer, and it is the size of this which offers a serious impediment to the plan. When it was smaller, where there was no lake, the natural current of the stream no larger a stream then than it is now was sufficient. But when it was dammed up there was not current enough in it to sufficiently agitate so large a body. If it were possible to reduce the size of the lake in summer, the present supply might keep it pure: but the consumption is so near the amount furnished that this

reservoir has to be kept to draw on in a dry season, for without it the necessary city supply might fail. If a stream were introduced large enough to obviate the danger of this, thus doing away with the necessity for keeping a large amount stored up, it might assist as long as such an abundant supply was used by setting aside the necessity of having Rensselaer lake at all, in which the difficulty first occurs, thus producing the conditions of the original stream.

But few cities, however, have a sufficient source of supply to rely on throughout the year without a reservoir in reserve, as is the case in Albany, and all such will be liable to this constantly recurring evil. With the increase in this city that is indicated by its previous growth, reservoirs will soon have to be reestablished here even if they are temporarily set aside by additional supplies, that can only be drawn from the limited sources of water high enough to be led into the upper parts of the town.

It is not a difficult matter to prevent the stagnation of a body of water as large as Rensselaer lake. It should be deepened into a reservoir (as indicated by the line E, page 314), that has uniform depth and is capable of holding as much as it does now. If the limited current it will then possess is insufficient for the purpose, motion can be given it by mechanical contrivances. For this purpose, if it is made elliptical in form, with its foci connected by a wall higher than the surface, a motion around the lake as rapid as the current which purifies the river, can be given the water at but moderate expense, during the short time in the heat of summer that a lake with proper depth would require it.

We are all familiar with the rapid current made by the wheels of a steamboat when aground, or fastened to and trying to move some immovable object, as another grounded boat. Such a small steamer of the commonest model, anchored on one side of the lake would produce the neces-

sary current, much as the old fashioned way of having a number of persons eat their soup from the same dish, which prevailed among the earlier settlers of the country, set the contents of the dish in rotation.[1] Or a water wheel driven by steam might answer equally well. The only practical question arising, will be as to the amount of power needed in an engine capable of driving a wheel or pair of wheels dipping into the water in the manner of those of a small steamboat; such a question is of course easily settled. For the first day or two, perhaps, it only disturbs its surface; soon the whole body of water in the lake partakes of the motion, and but little power is needed to keep it moving. If its direction of motion be calculated with reference to the direction of the outlet, an additional current can be added to the latter, a point of no small importance to a city situated as Albany is, with a limited head for supplying the upper portions.

Another advantage resulting from such motion, is in its preventing so high a temperature as is now found on the surface in summer, from being produced in the water: this, besides many other advantages resulting from it, would to some extent hinder evaporation.

In this connection it is well to notice one objectionable feature in the methods of leading water now employed.

The habit is too common in engineers, of carrying it only in closed pipes when it is brought for long distances, and this deprives it of one of the best agencies for keeping it pure. The amount of dead matter which open channels would collect in the form of falling leaves and similar refuse, would not affect it any more than it does the water of running streams.

[1] It is related of one large land owner that he was induced to discharge a left handed laborer for the reason that he obtained more than his proportion of bread by dipping against the current which his right hand associates had established in the dish of bread and milk that was furnished for supper.

Thus generally, we shall find that the more we depend upon artificial processes and the greater the variance between our plans of leading and storing water, and those that we find in nature all about us, the greater will be the amount of impurity that poisons it for use.

On every side of us all the illustrations of how it may be kept in large or small amounts, from the rain drop to the largest lake, from the rill to the river. All is arranged in the great laboratory of nature that it may be kept in purity, and when we follow the plans there indicated it will be so kept for us.

ERRATA.

Page 257. 10th line from the bottom ; the word *proscribed* should be *prescribed.*
Page 258. 15th line; *effect* should be *affect.*
Page 271. 17th line from the top; *term* should be *turn.*
Page 272. 16th line from the top, a space should be inserted, between *be*, and *rashly.*
Page 274. 8th line; a comma should be placed after *moves.*

INDEX.

Abeel, Garrit, signer of bills, 75.
Agents sent to represent colonial interests in parliament, 44.
Aglaspis, genus, 173.
barrandi, 174.
Agnostus josepha, 169.
parilis, 170.
disparilis, 171.
Albany water supply, 313.
Alexander, James, signer of bills, 67.
Allen, L., essay on force and motion, by, 257.
Amherst, Gen., requests the issue of paper money, 51.
Amphion, genus, 193.
matutina, 194.
Andros, Governor, finances of administration of, 28.
Arionellus bipunctatus, 158.
Arms, projects for supplying, in revolution, 276.
Bache, Theophylact, signer of bills, 75.
Bancker, Evert, signer of bills, 75, 78.
Bank bills authorized, 26.
Banting, Wm., inquiries of, noticed, 241, 242, 244.
Barclay, Andrew, signer of bills, 74
Barometer, descriptions of automatic registering and printing, 1.
sources of error in, 21.
Barrande, M., researches of, 95, 131.
Bayard, Stephen, signer of bills, 67.
Beaumont, Dr., researches of, 250.
Beaver, a standard of money, 23.
Beekman, Gerandus, signer of bills, 63, 64, 65.
Beekman, Henry, signer of bills, 66.
Bellomont, Governor, advises a mint, 28.
Bernard, Professor, analysis by, 255.
Bibliorum codex Sinaiticus Petropolitanus, 229.
Billings, Mr., 108, 109, 110.
Bills of credit, *see paper money*.
Black river, Minnesota, fossils at, 113, 151, 170.
Blackwell, John, authorized to issue paper money, 26.
Bleecker, Anthony L., signer of bills, 75.
Bogert, John, Jr., signer of bills, 74.
Brachiopoda of Potsdam sandstone, 100.
Bradford, Wm , printer, 66, 67, 69.
Bradley, Mr., fossil found by, 94.
Bradley, Mr., 135.
Brewer, Jeremiah, signer of bills, 75.
Brinckerhoff, Abraham, signer of bills, 75.
Broome, John, signer of bills, 75.
Burnet, Governor, finances under, 35.
Caricatures suggested for devices of paper money, 54, 55.
Carolina, paper money issued in, 26.
Catalogue of issues of paper money, 57.
Census of New York, history of, by Dr. F. B. Hough, 196.
Chariocephalus, genus, 165.
whitfieldi, 166.
Clark, Governor, currency under, 40.
Clarkson, David, signer of bills, 68, 71.
Codex Alexandrinus, noticed, 237.
Codex Vaticanus, noticed, 239.
Coins used in colonies, 27, 28.
fluctuation in value of, 29, 30, 36.
attempt to fix value of, 42, 43, 51.
Conocephalites at Keeseville, 94.
genus, 96, 97.
described, 129.
minor, 132.
minutus, 134.
eos, 135.
perseus, 137.
shaumardi, 138.
nasutus, 140.
oweni, 141.
eryon, 143.
anatinus, 144.
patersoni, 145.
binodosus, 146.
winona, 148.

Conocephalites iowensis, 149.
wisconsensis, 151.
hamulus, 154.
diadematus, 156.
dorsalis, 194.
optatus, 195.
Continental money, scale of depreciation, 92.
Cornaro Luigi, dietetic experiments of, 245.
Corpulence, theory concerning, 241.
Cruger, Henry, signer of bills, 69, 70, 72, 73.
Cruger, John, signer of bills, 60, 61, 62, 64, 66, 67, 73.
Curaçoa, trade with, 36.
Dead River, rocks at, 185, 187.
DeLancey, Oliver, signer of bills, 70.
DeLancey, Stephen, signer of bills, 66.
Dendrograptus, species, 99.
hallianus, 99.
Denning, Wm., signer of bills, 75.
DePeyster, Isaac, signer of bills, 69, 70.
DePeyster, James, signer of bills, 71.
DePeyster, John, signer of bills, 57, 58, 78, 79.
Des Brosses, Elias, signer of bills, 74.
Dikelocephalus miniscaensis, 97.
minnesotensis, 97, 117.
var. limbatus, 121.
pipinensis, 97, 121, 122.
spinger, 124.
genus, 96, 97, 98.
described, 116.
misa, 126.
osceola, 128.
Dinwiddie, Gov., 48.
Discina, genus, 107.
inutilis, 108.
Dongan, Gov., advises a mint, 28.
Douglass, C. C., observations by, 185.
Drummond's island, rock formations at, 94.
Dudley Observatory, automatic record at, 19.
Electricity, application of, to meteorological registers, 2.
Encroachments of the French, 48.
Escanaba River, rocks at, 177.
Euomphalus vaticinus, 115.
Expeditions against Canada, 48, 49.
Fasoldt, Charles, mechanism made by, 15.
Fauna of the Potsdam sandstone, 93, 99.
Ferry rates, ancient, 24
Food, and its digestion ; a paper by Dr. Howard Townsend, 241.
Force, essay on, by L. Allen, 257.
Fortifications built by the aid of paper money, 34, 37, 48.
Fossils of Potsdam sandstone, 93, 99.
Foster. G. W., observations by, 185.
Franklin, Walter, signer of bills, 75.
French war, paper money issued on occasion of, 26.
Gaine, Hugh, printer, 75.
Gastropoda of Potsdam sandstone, 115.
Gouverneur, Nicholas, signer of bills, 70.
Grain used as currency, 24.
Graptolitidæ of Potsdam sandstone, 99.
Green Bay, rocks at, 94.
Hall, Prof. James, on fossils of Potsdam sandstone, 93.
Hayden, Dr., explorations of, 190.
Heyer, Wm., signer of bills, 78.
Hickcox, John H., history of bills of credit by, 23.
Hoffman, Nicholas, signer of bills, 79.
Holland, Henry, signer of bills, 75.
Holt, J., printer, 76.
Hough, Dr. Franklin B., history of New York census by, 196.
notices of Peter Penet and of his operations among the Oneida Indians, by, 275.
Hough, Prof. G. W., description of an automatic registering and printing barometer, 1.
Houghton, Dr., observations by, 184, 190.
Hunter, Gov., currency under, 29, 33, 35.
Illænurus genus, 167.
quadratus, 168.
Indian wars, expenses incurred in, 27, 30, 31, 44.
Interest, legal rate of, 38.
Jansen, Johannes, signer of bills, 59, 62, 63, 64, 65.
Jay, Peter, signer of bills, 67, 68.
Johnson, Simon, signer of bills, 67.
Jones, David, commissioner, 70.
Keeseville, fossils found at, 94.
Keweena point, rocks at, 185, 191.
Kickapoo, fossils at, 138, 139, 140.
Kip, Jacobus, signer of bills, 63, 64, 65.
LaCrosse, fossils at, 144.
LaGrange mountain, fossils at, 103, 115, 121, 122, 124.

Lake Pepin, rock formation and fossils at, 97, 114, 145, 170, 171, 187.
Lansing, Iowa, fossils at, 102.
Laurence, Jonathan, signer of bills, 78.
Laws relating to the currency, titles of, 81.
La Roux, Charles, engraver, 68.
Lingula genus, 100.
ampla, 101.
winona, 102.
mosia, 102.
aurora, 103, 104.
Lingulepis, genus, 106.
pinnaformis, 107.
Lispenard, Leonard, signer of bills, 72.
Livingston, Abraham, signer of bills, 75.
Livingston, John, signer of bills, 70.
Livingston, Peter V. B., signer of bills, 73.
Livingston, Philip, signer of bills, 72.
Livingston, Robert G., signer of bills, 74.
Livingston, Robert R., 73.
Livingston, Robert, Jr., signer of bills, 66, 69.
Loan commissioners created, 40.
Loan, distribution of a, 39.
Logan, Wm. E., 178, 179.
Loudon, S., printer, 77, 78.
Ludlow, Gabriel, signer of bills, 71.
Lurting, Robert, signer of bills, 57, 58, 59, 60.
Lynson, Abraham, signer of bills, 69, 70, 71.
McCue, Mr., observations made by, 22.
McCormick, Daniel, signer of bills, 79.
Madeira, trade with, 36.
Magendie, researches of, noticed, 248.
Marston, Nathaniel, signer of bills, 74.
Maryland, tobacco a legal tender in, 25.
Massachusetts, paper money in, 25.
Mazomania, Wis., fossils at, 103, 104, 108.
Menomonee river, rocks at, 177, 179.
Mercey, William, signer of bills, 75.
Miller, Eleazer, signer of bills, 75.
Miniska, Min , fossils at, 175.
Mint, proposals to establish, 24.
Money, representatives of, 23.
Moore, Dr. Francis, fossils obtained from, 114.
Moore, Gov., currency under, 52.
Moore, John, signer of bills, 68.
Mosher, Dr. Jacob S., paper by, on water and its impurities, 304.
Motion and force, essay on, by L. Allen, 257.
Murray, Mr., 185.
New England currency, 24.
New Netherland currency, 23.
New York, bills of credit issued in, 27.
New York census, history of, by Dr. F. B. Hough, 196.
Obolella genus, 108.
chromatica, 110.
polita, 112.
Oneida Indians, Peter Penet's operations among, 275.
Orthis genus, 113.
pepina, 113.
Osceola Mills, fossils at, 100, 114, 147, 168, 172.
Owen, Dr., D. D., 93, 94, 95, 96, 97, 99, 101, 103, 104, 105, 107, 109, 110, 116, 124, 125, 129, 130, 131, 142, 147, 153, 154, 156, 159, 163, 175, 176, 191,
Palæontology, contributions to, 93.
Paper money, history of, 23.
introduction of, 25.
issued in 1690, 26.
subsequent rise of, 26, 27.
in New York, 27, 30, 33, 36, 37.
issued on occasion of war with Canada, 30, 31.
fortifications built by aid of, 35, 37.
under Governor Burnet, 35.
for promoting Indian trade, 36.
under Governor Clark, 40.
objections against, in parliament, 44.
canceled by a tax, 44, 45.
under Governor Clinton, 46.
amounts issued by colonies, 47.
not to be used as legal tender, 48, 55.
issued on occasion of failure of expeditions against Canada, 50, 51.
under Governor Moore, 52, 54.
provincial congress takes action upon, 55.
excessive issues of, 56.
catalogue of New York issues, 57.
recapitulation of, 80.
list of acts relating to, 81.
rate of depreciation, 92.
Parker, James, printer, 69, 70, 71, 72, 73.

Pemphigaspis, genus, 193.
bullata, 193.
Penet, Peter, notice of, and of his operations among the Oneida Indians, by Dr. F. B. Hough, 275.
Pennsylvania currency, 25.
Philipse. Frederick, signer of bills, 66, 67, 72.
Photography used in meteorological cal registers, 2, 16.
Pitt, energetic measures of, 50.
Plan of government prepared for Oneidas, 296.
Platyceras primordialis, 115.
Potsdam sandstone, 93.
equivalents of, 95.
supplementary note to article on, 178.
Provincial Congress, action concerning public credit, 55.
Provoost, David, signer of bills, 60, 61, 62, 63, 64, 65.
Ptychaspis, genus, 160.
miniscaensis, 161.
granulosa, 163.
sp ?, 165.
Radcliffe Observatory, photographic barometer at, 16.
Rain, suggestions for recording, 20.
amount of, 304, 305.
Ray, Robert, signer of bills, 75.
Read, John, signer of bills, 61, 75.
Reade, Lawrence, signer of bills, 57, 74.
Reed's Landing, fossils at, 114.
Remsen, Henry, signer of bills, 78.
Richard, Paul, signer of bills, 69, 70, 72.
Robinson, Beverly, signer of bills, 72.
Rowe, Wm., signer of bills, 68.
Rutgers, Anthony, signer of bills, 66.
St. Augustine, expedition to, 26.
St. Croix, lake and river, rock formations at, 97, 100, 101, 104, 105, 107, 109, 110, 114, 140, 158, 159.
St. Mary's river, strata at, 94.
St. Peter's sandstone, 94.
Saline properties of inland seas, 307, 308.
Scott, John Morin, signer of bills, 74.
Schuyler, Peter, signer of bills, 67.
Sebring, John, signer of bills, 75.
Shipman, S. V., fossils found by, 120.
Shumard, B. F., 93, 96, 97, 132, 134, 149, 151, 153, 159, 182, 188.
Simons, Thomas, 3.
Sinai Bible, paper by Dr. Howard Townsend, on, 229.
Smith, Wm. P., signer of bills, 73.
Spondylobolus, genus, 111.
Stillwater, Min., fossils at, 102.
Stuyvesant, Governor, currency introduced by, 24.
Sullivan, Owen, executed for counterfeits, 71.
Surinam, trade with, 36.
Swallow, Prof., observations by, 182, 183.
Temperature, suggestions for recording, 20.
Thompson, Wm., theory by, 270.
Tischendorf, Dr., antiquarian researches of, 229.
Tobacco a legal tender, 25.
Townsend, Dr. Howard, paper on the Sinai Bible, 229.
food and its digestion, paper on, 241.
Trade, colonial, 36.
Trempaleau, fossils at, 101, 102, 113, 115, 133, 144, 145, 146, 151, 153, 158, 187, 189.
Triarthrella auroralis, 169.
Tucker, Thomas, signer of bills, 75.
Van Courtlandt, Philip, signer of bills, 66.
Van Der Spiegel, John, signer of bills, 73.
Van Horne, Cornelius, signer of bills, 67, 69, 70.
Van Horne, John, signer of bills, 74.
Verplanck, Samuel, signer of bills, 75.
Virginia currency, 25.
Walters, Robert, signer of bills, 57, 58, 59, 60, 61, 62.
Walton, Wm., signer of bills, 72.
Wampum used as money, 23, 24, 27.
Water and its impurities, with reference to the supply of large towns, a paper by Dr. Jacob S. Mosher, 304.
Watts, John, signer of bills, 72.
West Indies, trade with, 30, 36.
Weyman, Wm., printer, 34.
Wheat used as a currency, 24.
Whitfield, R. P., acknowledgments to, 177, 192.
Whitney, J. D., observations by, 185.
Winds, suggestions for recording, 21.
Wyckoff, Hendrick, signer of bills, 79.
Zenger, John Peter, printer, 68.
Zewan, used as money, 23.

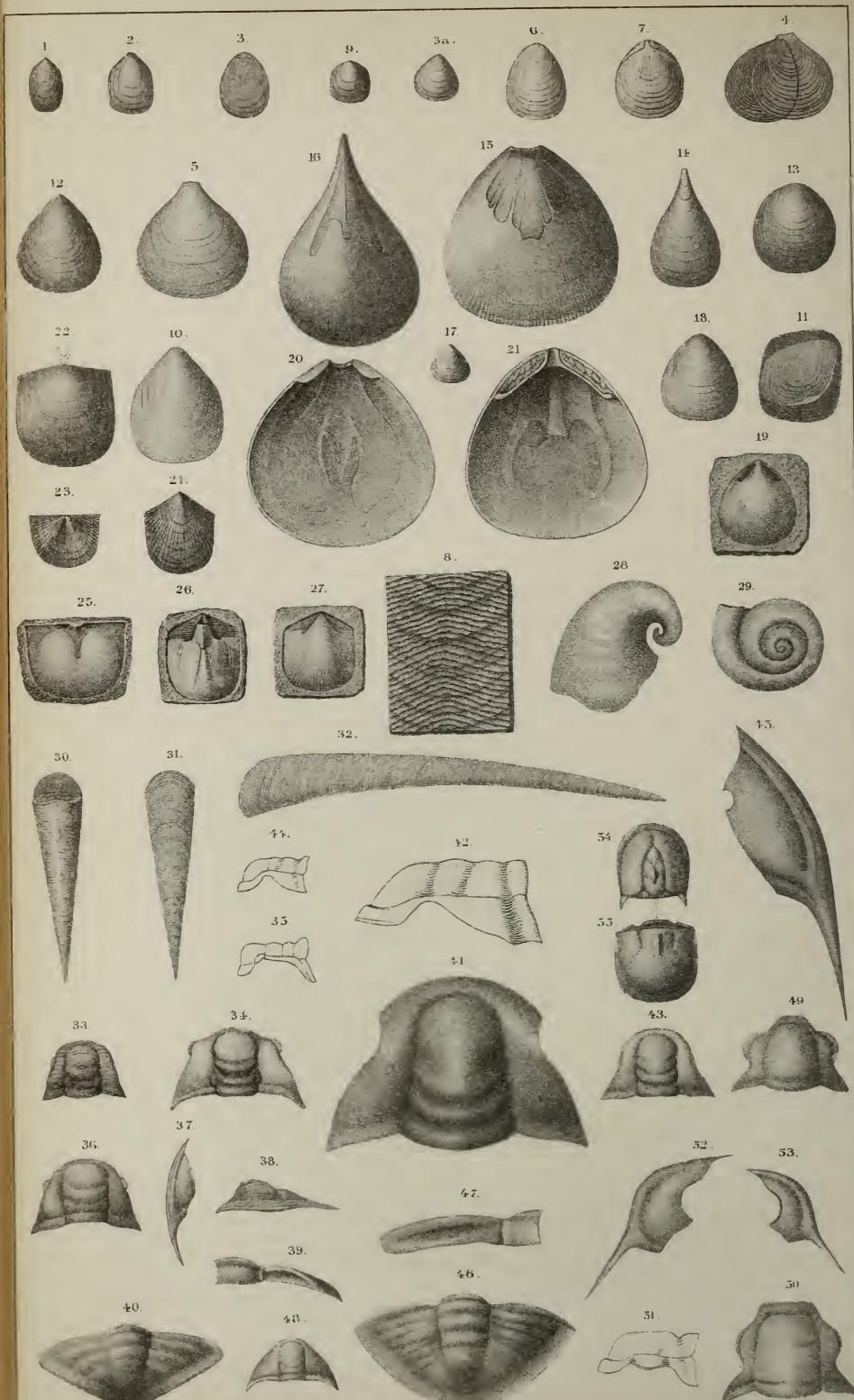

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PLATE I.

Lingula mosia.

Figs. 1, 2, 3. Varieties of form referred to this species, from Mazomania.
Fig. 3 *a*. A broadly ovate form of this species? from Stillwater.

Lingula aurora.

Fig. 4. A specimen showing the two valves slightly displaced.
" 5. A larger individual, probably the ventral valve, which is truncated at the extremity.

Lingula aurora, *var.*

Fig. 6. The exterior of this form, which is more nearly elliptical than the preceding.
" 7. A cast of the interior of a ventral valve of this species.
" 8. An enlargement of the surface, (of form like No. 5) showing the regular concentric lines of growth and the undulating lamellose striæ, which, crossing the lines of growth, give the apparently punctate texture.

Lingula winona.

Fig. 9. A figure of the specimen, natural size.

Lingula ampla.

Fig. 10. A figure of this species, of the natural size.

Discina? inutilis.

Fig. 11. A figure of the specimen, enlarged two diameters. The substance of the fossil has been partially removed, but the impression of the surface remains.

Lingulepis pinnaformis.

Figs. 12 & 13. Two forms of the shorter valve, which have been referred with doubt to this species.
" 15. An enlargement of the cast of this valve, showing a flabelliform muscular impression.
" 14. An elongate spatulate valve, which has the typical form of Dr. Owen's species.
" 16. An enlargement of the cast of a similar valve, showing the tripartite muscular impression.

Obolella? polita.

Fig. 17. A figure of a specimen, natural size.
" 18. An enlargement of a specimen of similar form.
" 19. A cast enlarged to the same degree as the preceding, and showing the cavities left by the articular bosses or muscular pads.
" 20. The interior of the ventral? valve, showing the muscular impressions, with a sinus at the apex. The figure is greatly enlarged.
" 21. The dorsal? valve, enlarged as the preceding, showing the muscular impressions with larger bosses or articulating surfaces of the cardinal line.
" 22. A brachiopod having the form of Strophomena or Strophodonta, but its generic relations are not determined.

Orthis pepina.

Fig. 23. A dorsal valve, natural size.
" 24. A ventral valve, natural size.
" 25. A cast of the dorsal valve.
" 26 & 27. Casts of the interior of the ventral valve, fig. 26 showing the vascular impressions.

Platyceras primordialis.

Fig. 28. A nearly entire individual. The specimen is of the medium size among those in the collection.

Euomphalus? vaticinus.

Fig. 29. The upper side of the spire. The specimen is somewhat distorted.

Theca primordialis.

Figs. 30 & 31. Figures showing the opposite sides of the shell.

Serpulites murchisoni.

Fig. 32. A figure of the natural size of the specimen.

Ptychaspis granulosa.

Fig. 33. A figure of a small head, enlarged two diameters, to show the exterior markings.
" 34. A cast of a larger individual, natural size.
" 35. A profile of the same in outline.
" 36. The head of a very small individual, enlarged three diameters. The specimen shows a broader glabella in front, with distinct eye-lobes on the fixed cheeks.
" 37 & 38. Profile and lateral views of a cheek of this species.
" 39. A part of a thoracic segment.
" 40. A large pygidium, corresponding with the one referred to this species by Dr. Owen.

Specimens of the head of this species, at least once and a half as large as fig. 34, have been seen in the same association.

Ptychaspis miniscaensis.

Fig. 41. The glabella and fixed cheeks of an individual of medium size.
" 42. A profile of the same.
" 43. A much smaller head, given for comparison with *Ptychaspis granulosa*, f. 34.
" 44. A profile of the same.
" 45. A cheek of this species, the figure of natural size.
" 46. A pygidium of the same species.
" 47. A segment of the body, found in the same association, but probably belonging to Chariocephalus.

Ptychaspis, sp.?

Fig. 48. The head of a very small individual of an undetermined species. It may possibly be the young of one of the above species.

Chariocephalus whitfieldi.

Fig. 49. The glabella and fixed cheeks, showing a curving frontal limb, and without visible furrows in the glabella, which is a cast. The figure of natural size.
" 50. A specimen preserving the glabella and fixed cheeks, where the frontal limb is nearly straight. There are two pairs of furrows distinctly marked in the glabella. The figure is twice the natural size of the specimen.
" 51. A profile of the preceding specimen.
" 52. A movable cheek of this trilobite, natural size.
" 53. A smaller movable cheek of the same species.

Agnostus josepha.

Fig. 54. The head of this species, showing the short spines at the postero-lateral angles.
" 55. The pygidium of the same species.

These figures are enlarged three diameters.

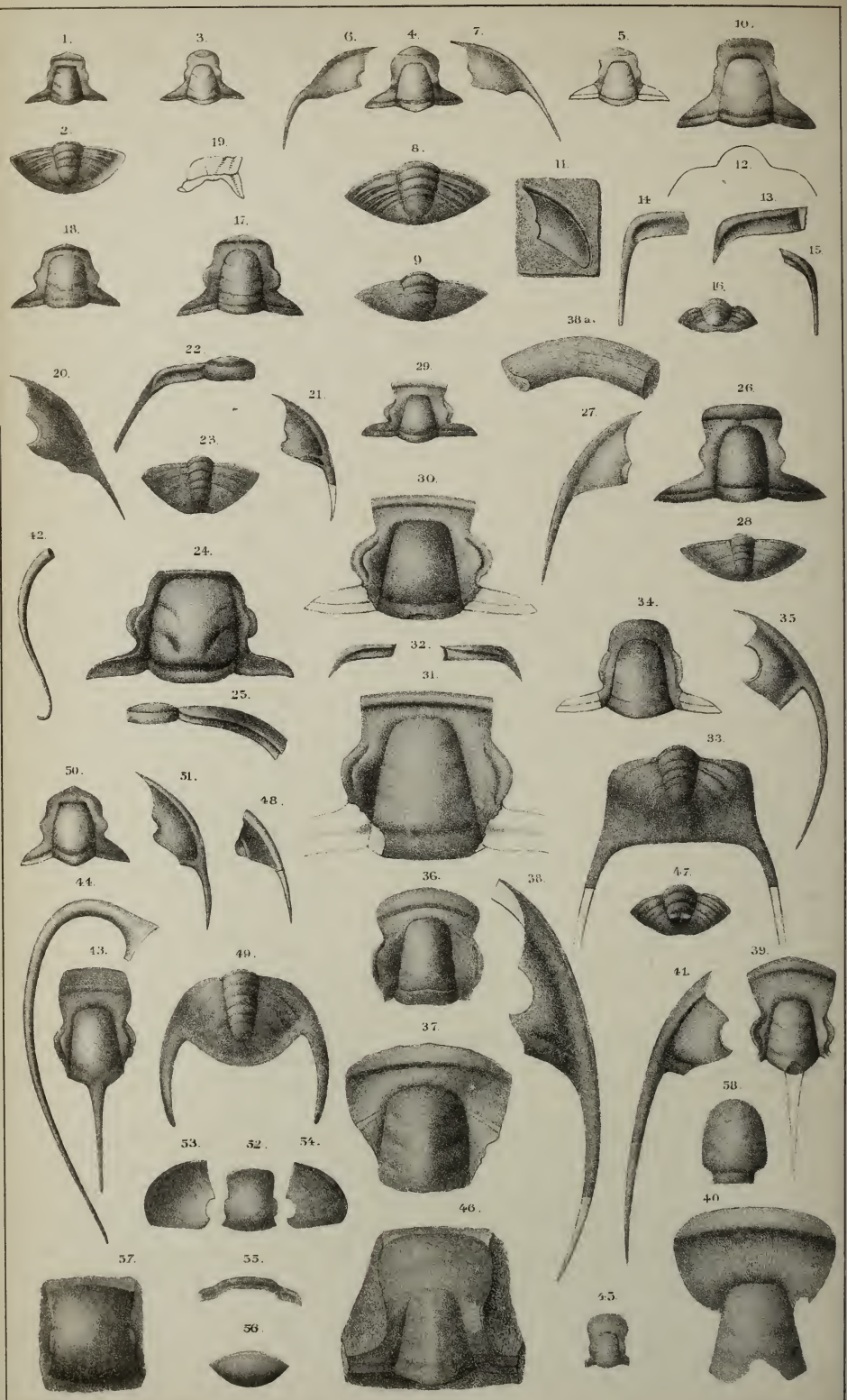
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PLATE II.

Conocephalites shumardi.

Fig. 1. A head, natural size.
" 2. A pygidium, natural size.

Conocephalites nasutus.

Fig. 3. A small head, natural size.
" 4. A larger head.
" 5. A very conical glabella.
" 6 & 7. Two forms of cheeks, associated with the heads.
" 8. A pygidium enlarged three diameters.
" 9. A pygidium enlarged two diameters, with two nodes on the terminal segment.

The figures 8 and 9 represent two pygidia found associated with the heads of *Conocephalites nasutus*. It is impossible at this time to determine which of them belong to the heads described.

Conocephalites eryon.

Fig. 10. A head, natural size.
" 11. Impression of a cheek.
" 12. A thoracic segment, in outline, occurring on the same stone with figures 10, 11 & 16.
" 13, 14, 15. Thoracic segments from different parts of the body. From Lacrosse.
" 16. A pygidium. From Trempaleau.

Conocephalites perseus.

Fig. 17. A small specimen twice enlarged. From Kickapoo.
" 18. A head, natural size; a shorter form, from Root river.
" 19. Profile of the same.
" 20 & 21. Two forms of cheek, associated in the same rock.
" 22. Part of a thoracic segment.
" 23. A pygidium, natural size.

Conocephalites eos.

Fig. 24. A head of this species,
" 25. An imperfect thoracic segment.

Conocephalites winona.

Figs. 26, 27 & 28. A head, cheek and pygidium, enlarged three diameters.

Conocephalites iowensis.

Fig. 29. A small head: from Trempaleau.
" 30. A larger head: from Black river.
" 31. A large head: from Root river.
" 32. Parts of thoracic segments.
" 33. A pygidium partly restored, showing the peculiar furrows in the ribs of the lateral lobes; from Black river.

Conocephalites anatinus.

Fig. 34. A glabella.
" 35. A cheek, associated with the same. Three miles above Reed's landing, Lake Pepin.

Conocephalites diadematus.

Fig. 36. A glabella: from Marine mills.
" 37. A larger glabella: from Root river.
" 38. A cheek: from Root river. The outline in front *a*, shows the extension of the "*doublure*," or lower side of the frontal limb.

Conocephalites wisconsensis.

Fig. 39. A head, with spine restored, in outline: from Trempaleau.
" 40. A part of a larger head: from Trempaleau.
" 41. A cheek, from Trempaleau.
" 42. A spine, from Lake Pepin (probably a cephalic spine of this species).

Conocephalites hamulus.

Fig. 43. Glabella with spine: from Miniska.
" 44. A spine (of Lonchocephalus), belonging to this species?

Conocephalites patersoni.

Fig. 45. A small glabella.
" 46. A large glabella.

Conocephalites binodosus.

Fig. 47. A pygidium, with nodes, showing three segments besides the terminal one in the axis, and three divided ribs besides the anterior articulation: axis wide and strong.
" 48. A cheek of this species?, in the same rock at Osceola.

Dikelocephalus Osceola.

Fig. 49. A pygidium with spines, the axis narrow; five articulations besides the terminal one; the lateral lobes with four or five annulations, and the anterior ridge terminating in a border; the anterior margin curved and extended in a spine.

Arionellus bipunctatus.

Fig. 50. Glabella and fixed cheeks, twice enlarged: from Root river.
" 51. A cheek, twice enlarged: from Lawrence creek.

Illænurus quadratus.

Fig. 52. A glabella.
" 53, 54. Cheeks of different individuals.
" 55. A thoracic segment.
" 56. A pygidium.
" 57. A larger glabella.

Conocephalites nactus (n. s.).

Fig. 58. A small species with ovate conical glabella which is marked by three distinct pairs of furrows, the posterior ones of which extend obliquely backward nearly to the occipital furrow. It is somewhat larger and less prominent than *C. minor*, with a narrow occipital ring without spine. It occurs in the lower beds of the sandstone near the mouth of Black river, Wisconsin.

POTSDAM SANDSTONE.

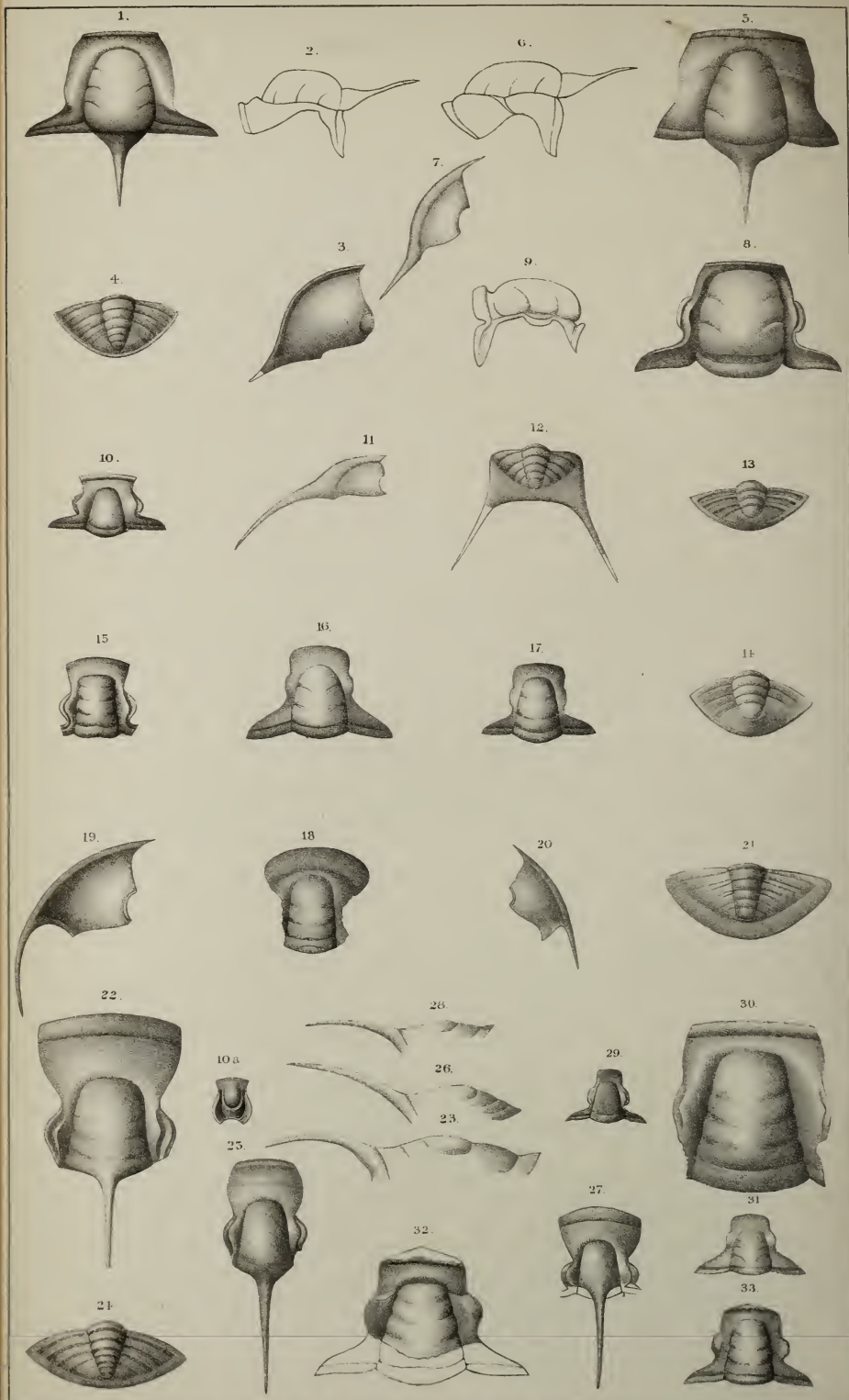

PLATE III.

Conocephalites minor.

[Figures four times enlarged.]

Fig. 1. The glabella and fixed cheek.
" 2. Profile of the same.
" 3. A movable cheek.
" 4. A pygidium of the same.

Conocephalites minutus.

[Figures four times enlarged.]

Fig. 5. Glabella and fixed cheeks.
" 6. Profile of the same.
" 7. Cheek of the same species.

Conocephalites eos.

Fig. 8. Glabella and fixed cheeks.
" 9. Profile of the same.

Conocephalites iowensis.

Fig. 10. A small head. The glabella is represented too round in front. *See figure* 29, *Plate* vii.
" 10 *a*. Hypostoma of this species.
" 11. A cheek of the same species.
" 12. A pygidium of the same.

Ptychaspis granulosus?

Fig. 13. A pygidium, which is of frequent occurrence in slabs containing the head of this species.
" 14. The pygidium of an undetermined trilobite.

Dikelocephalus misa.

Fig. 15. The glabella and fixed cheeks of this species. The glabellar furrows are not properly copied in this figure. *See figure* 4 *of Plate* 5.

Conocephalites eryon.

Fig. 16. A glabella and fixed cheeks of this species. The glabella is represented too round in front. *See figure* 10, *Plate* vii.
" 31. A similar specimen from Lacrosse. The anterior pair of furrows are rarely seen.

Conocephalites oweni.

Fig. 17. A glabella and fixed cheeks.
" 20. A movable cheek from the same specimen in which the head is found.

Conocephalites diadematus.

Fig. 18. The glabella and frontal limb of this species showing a very narrow space between the former and the elevated portion of the latter.
" 21. A pygidium, associated in the same specimens of stone with the glabella: from Marine mills.

Conocephalites shumardi.

Fig. 19. A movable cheek, referred with some hesitation to this species: from Marine mills.
" 32. Part of the glabella and fixed cheeks restored in outline from other specimens. This is the largest individual seen.

Conocephalites wisconsensis.

Fig. 22. Glabella, frontal limb, and part of fixed cheeks; the glabella showing indistinct furrows.
" 23. Profile of the same.
" 24. A pygidium associated with the preceding specimens.
" 27. A smaller individual, not showing glabellar furrows.
" 28. A profile of the same.

Conocephalites hamulus.

Fig. 25. The glabella, frontal limb, and part of fixed cheeks; with a slender spine from the occipital ring.
" 26. A profile of the same.

Conocephalites anatinus.

Fig. 29. The glabella and fixed cheeks of a small individual, from Trempaleau.

Conocephalites perseus.

Fig. 33. Glabella and fixed cheeks of a small specimen from Kickapoo. The figure is twice enlarged.

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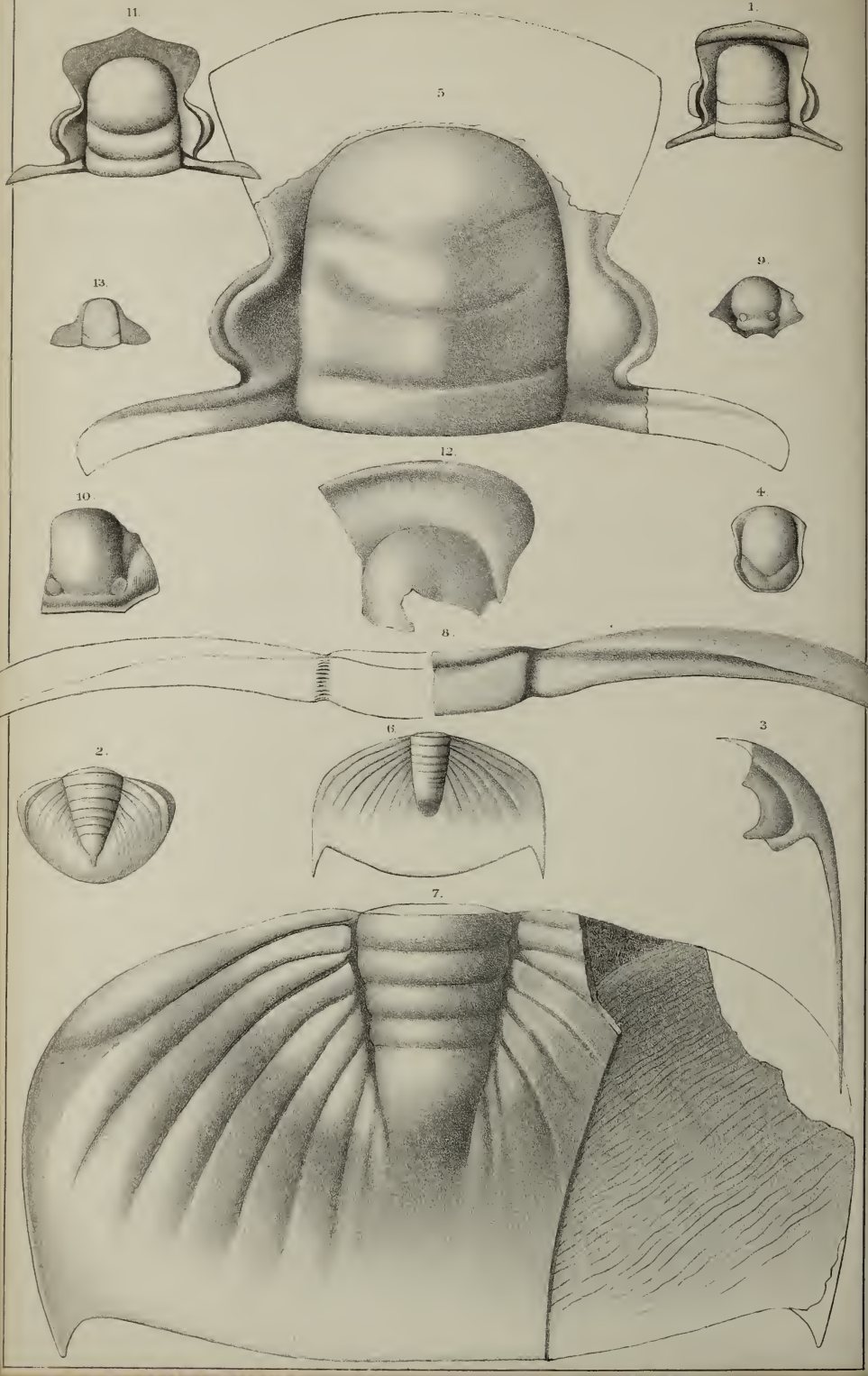


PLATE IV.

Dikelocephalus pepinensis.

Fig. 1. Glabella and fixed cheeks. The anterior furrows are scarcely shown in the figures.
" 2. Pygidium of the same species.
" 3. A cheek.
" 4. Hypostoma of the same.

Dikelocephalus minnesotensis.

Fig. 5. Glabella and fixed cheeks. The frontal limb is represented in outline, from another specimen in which this part is preserved. From Mazomania.
" 6. A small pygidium from Lagrange mountain.
" 7. A large pygidium from the Magnesian limestone near Madison, Wisconsin.
" 8. A thoracic segment; one side restored in outline.
" 9. Part of a small hypostoma.
" 10. Part of a larger hypostoma.

Dikelocephalus minnesotensis, *var.*

Fig. 11. Glabella, fixed cheeks, and frontal limb.

Dikelocephalus minnesotensis, *var.* limbatus.

Fig. 12. A part of the glabella and frontal limb of this variety.

Triarthrella auroralis.

Fig. 13. Glabella and fixed cheeks, twice enlarged. From Lagrange mountain.

PLATE V.

Dikelocephalus spiniger.

Fig. 1. Glabella and part of the fixed cheeks, showing the base of spine on the occipital ring.
" 2. An imperfect pygidium, associated in the same stone with the head.

Dikelocephalus, sp. ?

" 3. The cheek of a species which has not been identified: from Lake Pepin.

Dikelocephalus misa.

Fig. 4. The glabella and part of the fixed cheek.
" 5. A pygidium occurring in the same association; and the same is found on the specimens with fig. 4.
" 6. A part of a thoracic segment of this species? from the same block on which the glabella occurs.
" ? 7 & 8. Imperfect movable cheeks, apparently belonging to *D. misa;* occurring in beds where no other species of the genus are known.

Dikelocephalus minnesotensis, *var.*

Fig. 9. The glabella and fixed cheeks, having the frontal limb slightly extended in the centre: Stillwater.

Dikelocephalus minnesotensis.

Fig. 10. A head, restored from actual specimens of the glabella and cheeks.
" 11. Part of a thoracic segment which has apparently been a little bent near the axis.
" 12. A thoracic segment, more than half of which, on the left side, is from an actual specimen: the other part is restored to correspond with it.

Dikelocephalus pepinensis.

Fig. 13. The central portion of a small head.
" 14. A restored figure of a head from actual specimens.
" 15 & 16. Thoracic segments from different parts of the body, showing a little difference in the direction of the furrow. These segments occur in specimens associated with the heads, cheeks and pygidia of this species.
" 17. A pygidium of the same species.

Dikelocephalus osceola.

Fig. 18. The head twice enlarged.
" 19. A cheek, natural size: found in the same stone.

Chariocephalus whitfieldi.

Fig. 20. A head restored from actual specimens of the glabella and cheeks.

Ptychaspis miniscaensis.

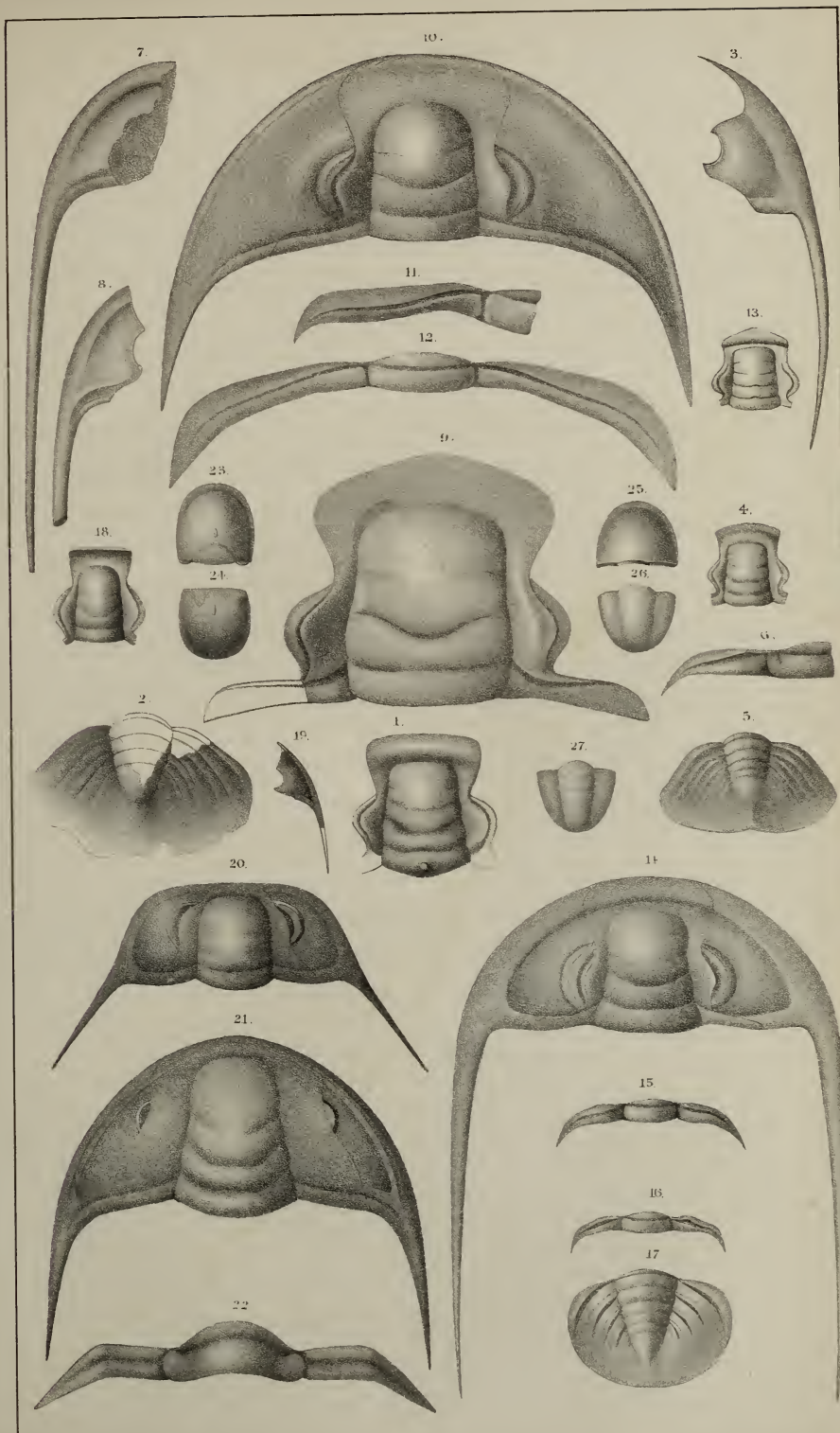
Fig. 21. A head restored from actual specimens of the separate glabella and movable cheeks. The cheeks appear narrower than when given separately; as they are shown in perspective, to correspond with the convexity of the head.
" 22. A thoracic segment: the right hand extremity is restored, to correspond with the actual portion on the left.

Agnostus parilis.

Fig. 23. A head, three times enlarged.
" 24. A pygidium, enlarged in equal degree.

Agnostus disparilis.

Fig. 25. A head, four times enlarged.
" 26. The pygidium of this species? four times enlarged.
" 27. A pygidium showing transverse furrows, equally enlarged.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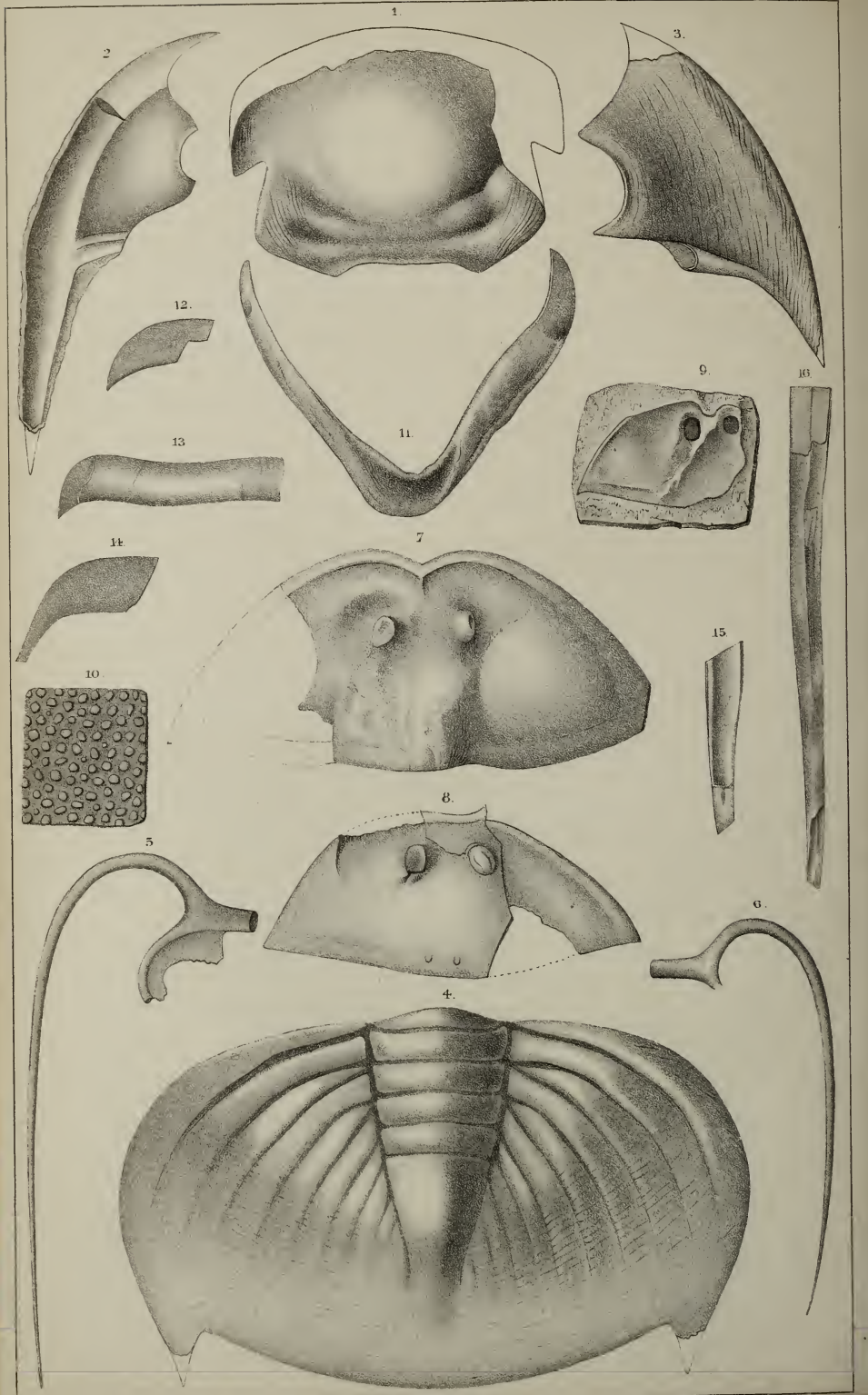


PLATE VI.

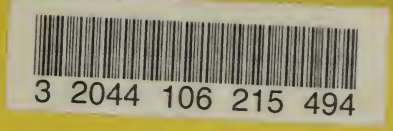
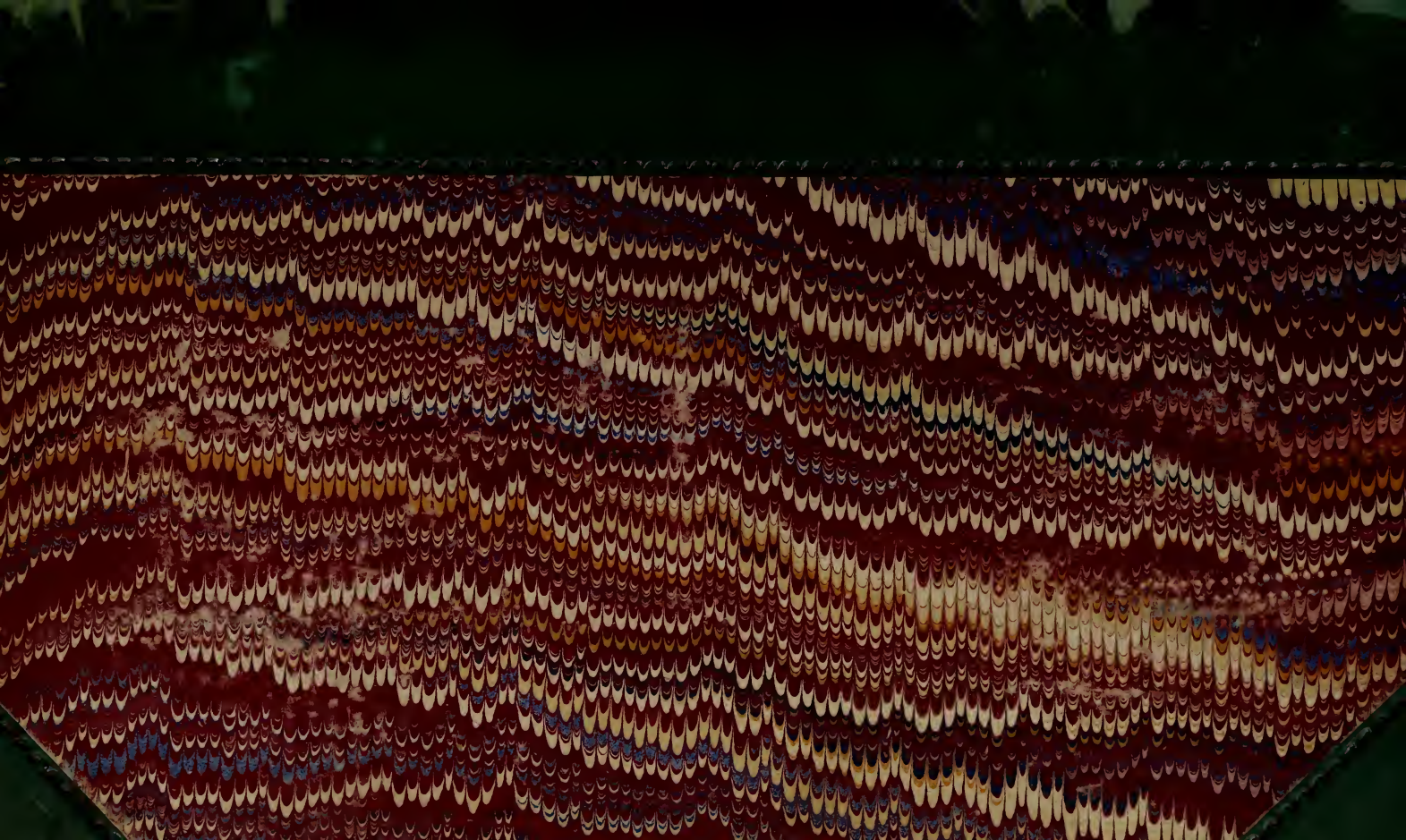
Dikelocephalus minnesotensis.

Fig. 1. The Hypostoma of this species.
" 3. A cheek of the same.
" 4. A pygidium of the same.

" 2. A cheek of *D. pepinensis?*
" 5 & 6. Spines of an undetermined trilobite, referred by Dr. D. D. Owen to *Lonchocephalus hamulus.*

Aglaspis barrandi.

Fig. 7. A large carapace of this species.
" 8. A smaller carapace, which is broken and distorted.
" 9. The lower surface of a part of a small carapace, showing the cavities of the eyes.
" 10. Enlargement of the surface.
" 11. A portion of the crust, which may have been of a segment at the posterior part of the body.
" 12, 13, 14. Fragments which appear to be the extremities of thoracic segments.
" 15, 16. Spines corresponding in character to the crust in other parts of the body; probably caudal spines.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